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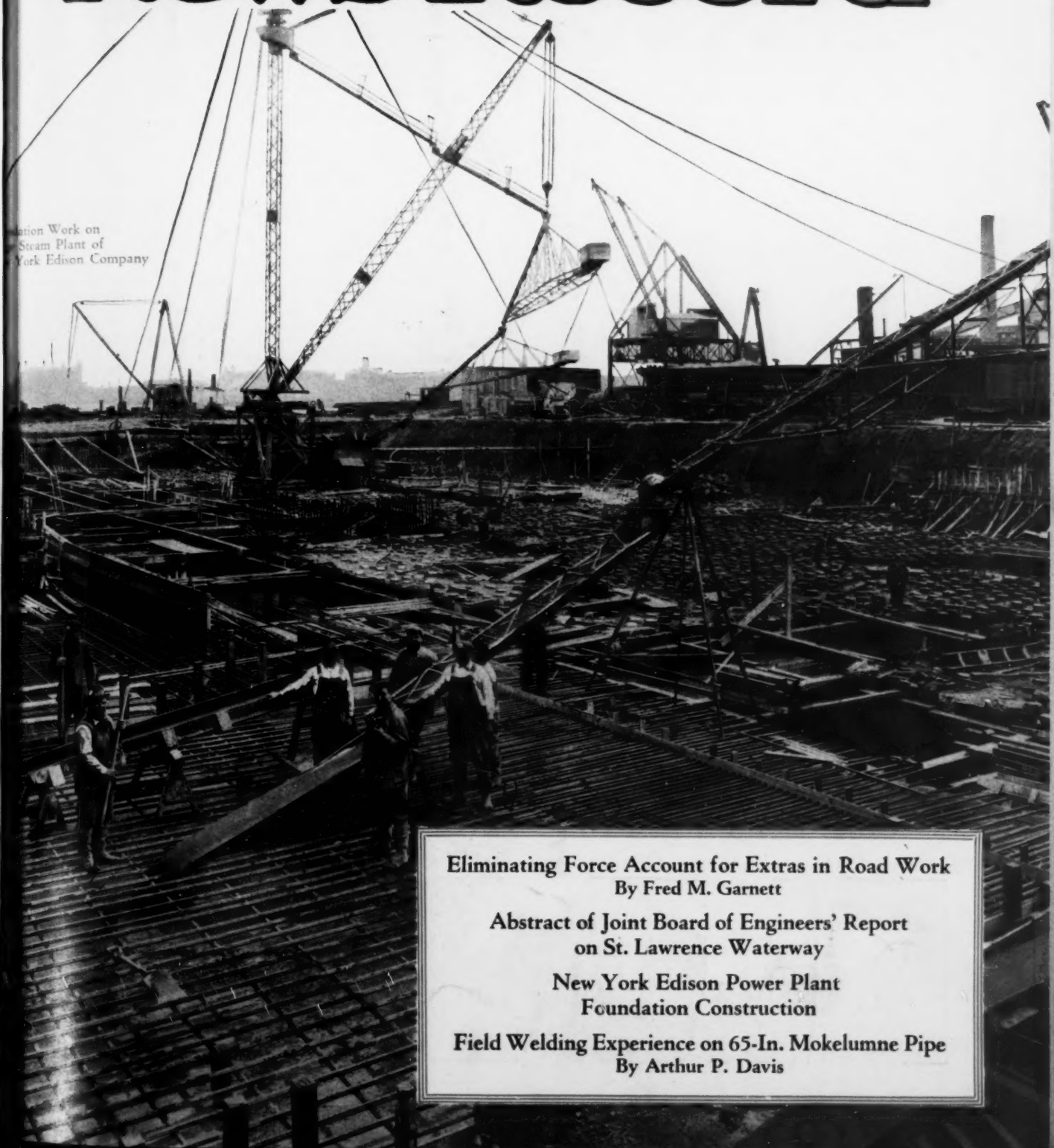

...ation Work on
...Steam Plant of
...York Edison Company

Eliminating Force Account for Extras in Road Work
By Fred M. Garnett

Abstract of Joint Board of Engineers' Report on St. Lawrence Waterway

New York Edison Power Plant Foundation Construction

Field Welding Experience on 65-In. Mokelumne Pipe
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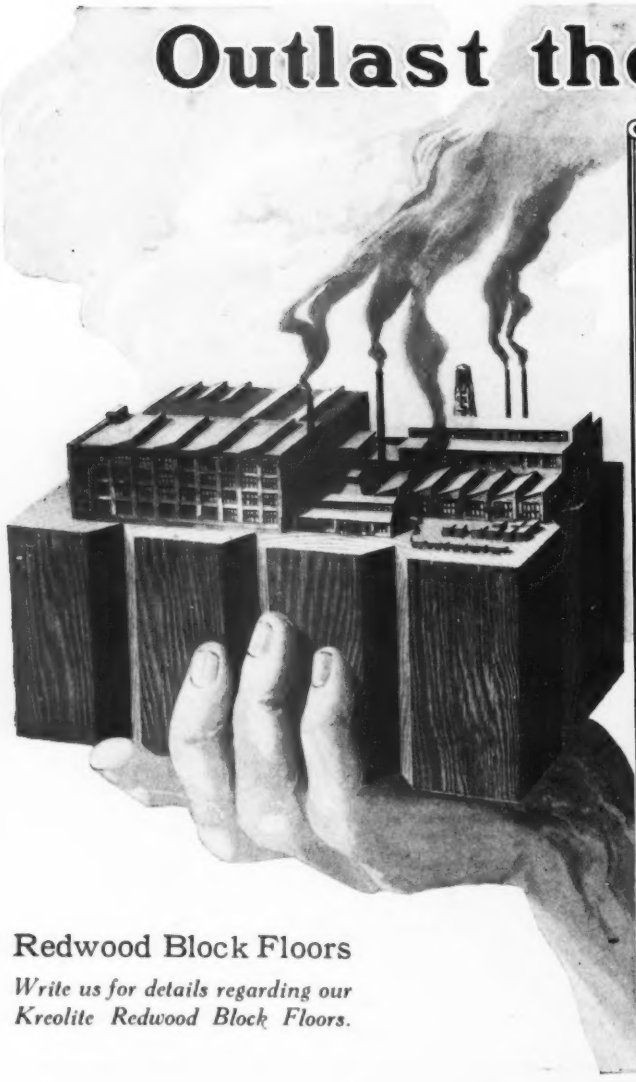

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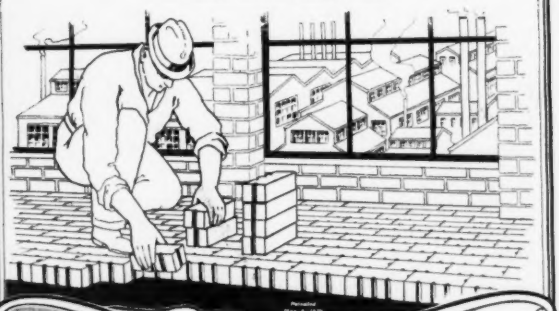

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Zoning Upheld

ANOTHER milestone in the steady progress of zoning is marked by the decision of the United States Supreme Court upholding the constitutionality of the zoning ordinance of Euclid, Ohio. Taking as already legally established the right to restrict buildings as to height and various generally accepted use nuisances, the Supreme Court now rules for the first time on the creation of strictly residence districts. It upholds this restriction, even to the exclusion of apartment houses from residence districts zoned against them. In effect, apartment houses are classed with other things which, although not nuisances per se, become such "when in the wrong place—like a pig in the parlor instead of in the farmyard." Discrimination, which by many has been held to be contrary to the essential spirit of our institutions, thus becomes constitutionally justified. Here, as elsewhere under the police power, the common good becomes supreme, regardless of the individual. The conservative state courts—decidedly in the minority—that have held zoning to be confiscatory have had their eyes so focussed on the property of the individual that they have entirely overlooked damages to the property of his immediate neighbors, and possibly to the whole city, which may far exceed those of the individual. In effect, and almost in words, the United States Supreme Court holds that in the uses to which real estate may be put the will of the majority, expressed through its governing body, is supreme. The state courts that have held otherwise — notably in New Jersey, Maryland and Texas—may profit by this example.

Excellent Plant Planning

AS AN example of the complete mechanization of concrete production and placing, the construction plant described in this issue for the new power plant of the New York Edison Co. commands attention. Two things in this plant layout stand out perhaps most prominently: its compactness considering the output required and its arrangement to permit concreting to go on with slight interference with the ground operations of excavation and piledriving. By any standard, a thousand yards a day, even in foundation construction, is a lot of concrete for a building operation. With a train of mechanism consisting of gantry cranes, belt conveyors and bucket elevators to the mixers and from the mixers of tower hoists and chutes to the forms, excellent co-ordination of plant units is required to guarantee a thousand yards daily of concrete in place with a thousand feet of conveyors. In respect to the provision of free working space for pile drivers and power shovels no device perhaps could have excelled the aerial concrete handling system which was installed. The article mentions that nine plant layouts were compared before the one described was selected. This statement is an excellent illustration of the high quality of engineering analysis devoted regularly today by large construction organizations to planning construction plant. In it is a lesson to all constructors.

Bay Bridge Progress

A DISTINCT SENSE of relief comes with the latest news of Bay Bridge developments in San Francisco. It will be remembered that two months ago the county supervisors held a series of hearings at which some seventeen or eighteen groups of applicants for a toll bridge franchise presented their respective arguments why the franchise should be awarded to them. Each group had a site, a design, and money (or promise of money). The board of supervisors was expected to decide which particular combination was best—this, be it noted, in perhaps the greatest bridge project in the world's history. To put it mildly, the hearings disclosed a charmingly naïve attitude toward the task of bridging the bay, on the part of the chosen wardens of the public welfare. Apparently it had not occurred to them that such a bridge project is made up of many separate questions each of which is a most formidable problem in itself, requiring independent study and determination from the viewpoint of the public rather than from that of a concessionnaire. Calmer reflection subsequent to the hearing now seems to have opened their eyes to this aspect of the matter, with the result that, as noted in this week's news, they have postponed indefinitely the consideration of the toll-project hearings. They will proceed to have their own board of engineers determine the governing points of the project—such as location, type, capacity and the like—and only after the project has thus been made definite will they consider the question of public or private construction. This is a belated but wholly satisfactory development. It rescues the great Bay Bridge project from the state of hopeless absurdity in which the supervisors' hearings had placed it. The project now promises to go ahead on a sound and progressive basis.

Rate Making Theory Advanced

ONCE more the reproduction cost new theory of valuation is discussed in a United States Supreme Court decision, this time in that on the rate to be charged by the Indianapolis Water Co. In general, the court maintains its oft-repeated upholding of the famous Smyth-Ames ruling that the present cost of a property is its value for rate-making purposes, but the court continues to hedge this decision around with the usual amendment which makes it in fact what it always has been, merely an indication of a tendency and not a citing of a rule. In other words, as the court says, "The weight to be given to such cost figures is to be

determined in the light of the facts of the case in hand." The justification for the investment, the degree of use, the market value of the property as expressed in the securities, and other elements in the so-called prudent-investment theory must enter into the determination of value. This is well indicated by the fact that in the Indianapolis case the spot reproduction would be some three or four million dollars greater than the value accepted by the company and stated by the court to be proper. We are, therefore, no nearer than we ever were to an absolutely precise rule by which we can measure the base value on which rates are to be made. Nor are we any better informed as to what is going to happen in rate making when, or if, we run into an era of lowered unit prices. Two other features in the decision, however, are of importance. The first is the expressed statement of the court that an actual engineering estimate of depreciation based on an examination of the property is to be preferred in the establishment of value to any theoretical depreciation figured out by any of the many formulas extant. The second is the ruling of the court that 7 per cent is none to little as a fair return on a capital investment in a public utility. Rate-making of public utilities is a slow process. It is built up only by repeated decisions and not by single ones or by statutes. The Indianapolis case is just another one to add to the trend of judicial thought. It is not epoch-making, but it is important.

Budgeting vs. Logrolling

BY A revolutionary but constructive proposal to the irrigation committees of Congress, the federal Reclamation Bureau has just made the start toward a thoroughgoing reform of the method by which reclamation work is undertaken. It has budgeted reclamation expenditures by compiling a ten-year program of work, whose remarkable feature is that it totals nearly a hundred million dollars, and yet covers only the completion of projects already begun. This hundred million obviously represents an accrued obligation of the government. That so large an obligation for development could have accrued is just cause for wonder, but it has a ready explanation. Heretofore, during twenty years or more, each successive Congress has ordered (or tried to order) new projects to be begun, regardless of the fact that the available money was already committed up to the hilt in the prosecution and completion of prior projects. Each Western delegation made a point of trying to get an appropriation for its state, and a logrolling or pork-barrel system thus grew up. It has been the most serious disease of reclamation. The budget plan offers hope for a cure. It is revealed by the present, first, budget that there is no possibility of starting new projects for a number of years, but that the full revenue of the reclamation fund will be required to fulfil commitments already made. This may be an unpleasant fact for the Western legislator to face, but it is healthy. He ought to face the fact, and in doing so come to realize that if he insists on overdoing reclamation, if he will delay the completion of already begun projects in order to get additional ones started, he will further stunt and injure the West, as it already has been much injured in the same way. Of course the proposed budget is not binding on Congress; if its value is realized, however, Congress will adopt it and make it the guide for its own future acts.

More Facts on the St. Lawrence

NO RADICAL changes in engineering thought on the proposed St. Lawrence River project are contained in the report of the new international Board of Engineers abstracted in other pages of this issue. In its major features the report confirms the recommendations of the earlier Wooten-Bowden report, but confirms those generalities and changes the details on the basis of the more thorough study that five years' time and some hundreds of thousands of dollars of expenditure permit. The proposal still is, as it was in 1921, that the river be canalized from Ontario to deep water at or below Montreal by a major dam which would pool the river from the lake to the second rapids and by side canals and river deepening for most part of the remainder, and that power be developed incident to this improvement.

Details of the developments, however, are changed. Instead of a control dam at Morrisburg, which the earlier report recommended, the board divided on international lines, the Canadians backing up the Ontario Hydro in its plans for a two-stage power development with one dam at Morrisburg and the other in the Long Sault and the Americans recommending a single-stage with the dam also in the Long Sault. There are changes, too, in the location of some of the canals, notably at Montreal where the growing suburban districts have made it desirable to move the canal nearer the river than was thought necessary in 1921 and between Lakes St. Francis and St. Louis, where the board again divides on specific treatment. There is, too, the recommendation for control, but not regulation, of the lakes, but comment on that must be reserved until more of the report is available.

All in all, the report shows no great difference from the earlier plan which premised the improvement on the desirability of providing a navigable channel with a side benefit from the power so developed. It is true that the earlier plan estimated the total cost for nearly 1,500,000 hp. and a 25-ft. channel to be around $252,000,000, whereas the present scheme finds that the cost will be $100,000,000 more than that for that same project, but there has been a feeling ever since 1921 that the estimates of that report were too low, in spite of the fact that they were made at a time when unit prices were the highest in history. The present report, too, shows that the cost of the entire power and navigation development from Lake Ontario to the ocean is going to be around three-quarters of a billion dollars, which confirms also the belief that the entire St. Lawrence project means about a billion dollars when everything is taken care of.

At any rate, the engineers have done their work. They have not argued the economic or national feasibility of the project, for that was not within their instructions, but they have shown that a navigable waterway can be produced, that 4,000,000 to 5,000,000 hp. is available in the producing, and that the costs are, if enormous, still within the resources of the two countries. What remains is for the diplomats and the politicians to figure out some way in which two friendly national neighbors can utilize a joint natural resource to mutual advantage and without recrimination. And that is a far greater problem than the details of the engineering project.

Toll Bridge Reform

A STRONG and courageous resolution against toll bridges was adopted by the Association of State Highway Officials at its recent Pinehurst meeting. With this resolution, which is printed on p. 911, the association sounds a call to battle on an important issue and does a timely service. Legislative carelessness and neglect have created a situation whose reform is imperative.

The conditions which have led up to it and make necessary a new fight against toll bridges are remarkable. Only a few years ago toll bridges belonged to a forgotten age, a primitive time when the traveler was halted by barrier and pike at every step. The few remaining were rapidly disappearing when, quite abruptly, four or five years ago, a new era of toll bridges began. Since then their construction has been carried on at an increasing rate, and now has become a movement of such proportions as justly to give rise to alarm.

This new toll-bridge era is due to the fact that rapid growth of traffic within the past dozen years produced a crying need for more bridges, while public agencies lacked both the initiative and the financial resources to provide them. This made the opportunity for private initiative, and it turned out that franchises were easy to obtain on terms practically free from restriction. Capital remained doubtful for a time, and as late as five years ago a toll bridge undertaking could be financed only with great difficulty. About that time, however, the Bear Mountain bridge supplied the precedent needed to convince the notoriously timid and unimaginative financier, and soon a complete revolution of investment sentiment came about. Within the past three years capital has entered into keen competition for toll-bridge opportunities. In consequence we have today a considerable number of modern toll bridges, many more are under construction, and Congress as well as state and local legislatures are authorizing more at a rapid rate with no thought of the future. The movement is sharply in the ascendent.

Through this development, quite natural in itself, dangerous inroads have been made on a basic principle. Our present and future is built on ready intercommunication over open public highways penetrating everywhere, and abandonment of this system is inconceivable, although there is a chance, not too well recognized by our road authorities, that toll roads for special service paralleling existing, though congested, facilities may be quite feasible and proper. No monopoly highway utility should be permitted, however, and this principle is being definitely jeopardized by toll barriers now being erected at many river crossings.

In franchise grants for such toll bridges usually no thought was given to the essential fact that a perpetual toll barrier would be erected, subject only, perhaps, to the cumbersome and often unprofitable remedy of expropriation. Attempts to control or regulate toll bridges on sound principles were therefore rare.

Consistent stand was made against these tendencies by the federal Bureau of Public Roads, almost single-handed. No doubt the bureau perceived that if toll bridges continued to grow without regulation the entire public-road system might become a mere feeder to these private undertakings. On this view it has opposed congressional authorizations of such toll bridges as would be essentially exploitations of federal-aid road investiments, and has refused federal aid on roads which would serve principally as approaches to a private toll bridge. This attitude found strong legal support a month or two ago in an opinion by Controller McCarl which held that the anti-toll provisos of the federal-aid road acts prohibit the grant of aid in such cases.

Congress has been apathetic to the developing situation, but in one noteworthy instance state legislation has recognized the proper claims of public interest. The state franchise for the Bear Mountain bridge was limited in its duration to 30 years, with the further provisos (1) that at the end of this period the bridge should revert to the public and (2) that public purchase at any earlier period could be made at a *pro rata* amortization discount from the first cost. These provisions embody a thoroughly sound and logical attitude toward the toll-bridge problem, namely that of utilizing the traffic earnings to refund the cost of construction and so in measurable time extinguish the tolls. The legislators who drafted them are entitled to much credit for farseeing interpretation of a new economic condition.

So far as we know this sound principle has not found adoption elsewhere. Not only state charters and franchises but also the "model" form of bridge bills worked out by committees of Congress within the past year make toll bridges mere devices of exploitation with no thought of larger public purposes to be served. On the other hand the two outstanding recent cases of public toll bridges, the Delaware River bridge and those now being built by the Port of New York Authority, are based definitely and completely on the principle of toll refunding. These cases make it clear that the wisdom and feasibility of toll refunding are well understood. Nevertheless its application to private toll bridges has been rare.

The situation as a whole may be summarized in the statement that there is need for many major bridges, that to construct them on taxpayers' funds would in some instances defer them for many years, that present traffic is able and willing to pay for the improved facilities which the bridge would offer, out of the savings realized over the cost and delay of existing facilities—ferries or long detours—and that this ability may be utilized to retire the cost of the bridge and so in measurable time restore the necessary condition of a free road system; but that, on the other hand, this latter objective has been almost completely ignored in the practice of granting toll-bridge authorizations, with the result of creating a situation that is becoming a menace.

It is this evil, in essence, that the association's resolution deals with and that it seeks to correct. We strongly believe that the association's action is based on a truly sound appreciation of the public interest, and we shall look hopefully to see the cause advance toward constructive action.

Insofar as the resolution states that Congress alone can remedy the evil, and that states or cities are powerless, we believe it is in error. Proper franchise requirements can undoubtedly be imposed by them regardless of congressional bridge acts. But Congress, surely, should be the first to incorporate sound principle in its acts. On this ground we are heartily with the association when it directs its language at Congress and demands that that body take immediate steps toward a reform.

Foundation Construction, New York Edison Power Plant

Electrically Operated Equipment Takes Materials from Boats and Delivers Concrete Aerially While Excavation and Piledriving Proceed Without Interruption

PLANNING construction plant and methods for excavating 90,000 cu.yd. of earth, driving 20,500 piles and placing some 60,000 cu.yd. of concrete in twelve months is the work described here. This work was the construction of foundations for the two 60,000-kw. turbo-generator sets, one 40,000-kw. frequency changer, and their appurtenances of boilers, piping and condensing water intake and discharge conduits for the new power plant of the New York Edison Co., on the East River at 14th St., New York City. Plant layout then had to be for construction operations mainly below street level but covering a considerable area. Speed of construction also required methods and a plant plan which would permit excavation to be followed by piledriving and this by concreting as rapidly as each operation made room for the one succeeding. Finally, for plant placement, there was a definitely bounded area which, although not particularly cramped, required close planning to fit in so large an installation.

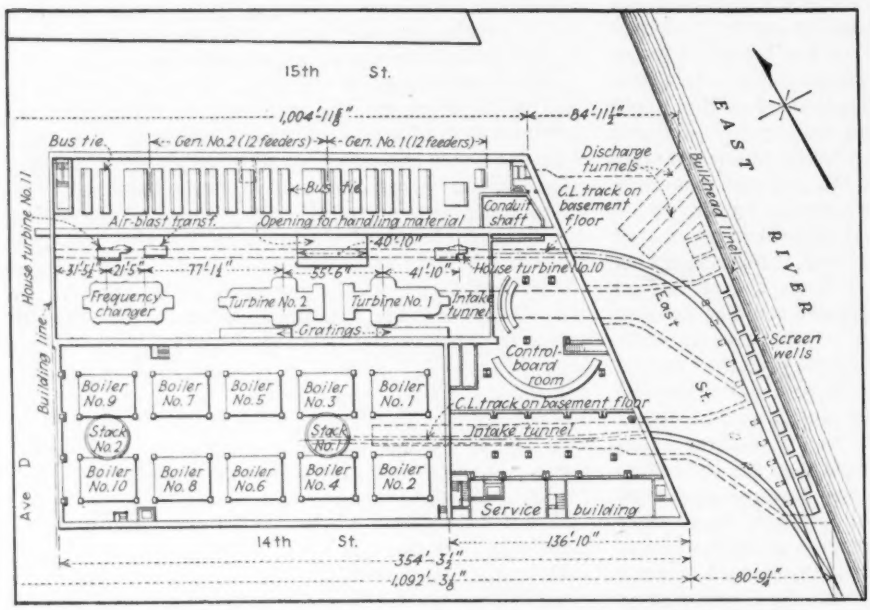


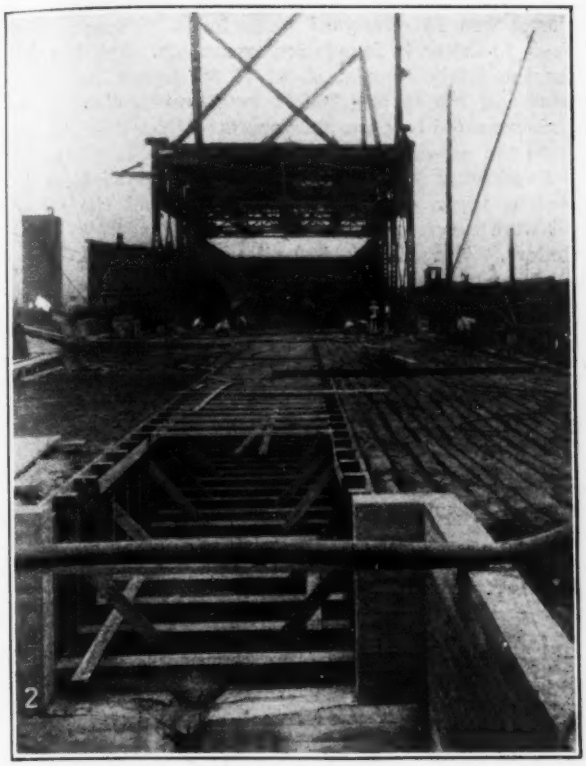
FIG. 1—PLAN OF RIVER FRONT STRUCTURES AND TWO POWER UNITS
There will be nine of these 60,000-kw. turbo-generator units in the completed plant.

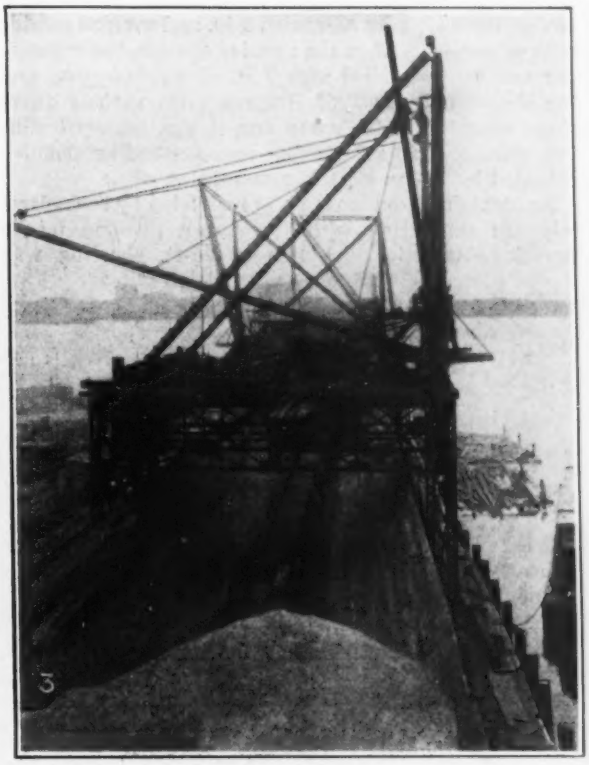
Structure to be Built—As planned, the power house is a seven-story building of concrete, brick and steel extending from the East River two blocks west to Avenue C, and between 14th and 15th streets. It is 206½ ft. wide and 1,092½ ft. long and is designed to house nine 60,000-kw. steam-turbine-driven generators each with its battery of boilers and electrical accessories, as indicated by the plan Fig. 1. A diagram cross-section is shown on the plant location plan Fig. 5; which, with Fig. 1, will aid in visualizing the structure. The plan Fig. 1 shows only the portion of the power house now being completed but the floor plan and equipment arrangement are virtually repeated the full length of the building. From the portion shown, extensions will be built as the business demands; indeed the foundations for the first extension about 270 ft. long were constructed as a part of the operation being described. In this operation were also included the river-front bulkhead wall and the screen-well structures which are shown in Fig. 1.

Specifically the structure to be built was the foundation shown by Fig. 4, with the river front structures. This foundation is a concrete mat 7 ft. thick on piles driven on 27 and 30-in. centers. A concrete fill between the top of this mat and the ground floor level encases condensing water intake and discharge pipes. It covers the area of the building now being completed, Fig. 1, and, across Avenue D, an area as wide and 209½ ft. long for the first extension. To prepare emplacement for this foundation structure an excavation 16 ft. deep was required, with cuts to greater depths for tunnel and screen well as indicated in part by Fig. 4 and described later. The quantities for the work have been given.

Location, Access and Plant Plan—The location to be utilized is shown by Fig. 5. It is on the river front. Between 14th and 15th streets are the building areas including the river-front bulkhead, screen well and intake tunnels. In the block between 14th and 13th streets and east of Avenue D is a slip from the river. This block and the slip were available for construction purposes. Also 14th St. could be closed east of Avenue D. There was then street access on three sides to the building sites and access by street and by water to the block available for materials storage and construction plant operations. Access by river direct to the operations dictated unquestionably that all major deliveries for construction purposes should be by water and the plant layout and design were developed on the basis of water delivery.

Production and distribution of concrete was the controlling operation affecting plant design. Excavation and piledriving were comparatively short-time operations by equipment largely mobile which would be moved in and taken out and in major part at least not be long required. The concreting plant had, however, to continue and operate throughout the building operation and might be required beyond this period for possible power house extensions. It had, therefore, to be of fixed location and of sound, lasting structure and it had to be fast and economical in operation—on occasions the construction schedule would call for a thousand yards a day of concrete in place. By this construction schedule too there must be simultaneous progress of excavation, piledriving and placing concrete. This laid down





FIGS. 2 AND 3—STORAGE BIN, CONVEYOR TUNNEL AND GANTRIES BEING ERECTED AND STORAGE BIN AND GANTRIES FROM ABOVE

the necessity of concrete distributing and placing methods which would leave the ground clear for excavating and piledriving. With the area to be served and the yardage to be handled aerial distribution seemed to be required and so from the first it was set down that hoist towers and a suspended chuting system would be the nucleus of any concreting plant plan.

A study was made of various equipment and arrangements for handling materials to storage and then to the mixer and for towers and chute lines and out of deeper cuts for intakes and river front structures. The ground was level. It was largely filled ground, mostly earth and sand with scattered stones, timber and old foundations and some boulders requiring blasting. Mean high water was about 7 ft. below curb level and the ground was wet to the surface. This necessitated drainage from the beginning if power shovel excavation was to be fully efficient. Thorough ditching to sumps and pumping effectively dried the ground giving a good foundation and working face for shovels for the first

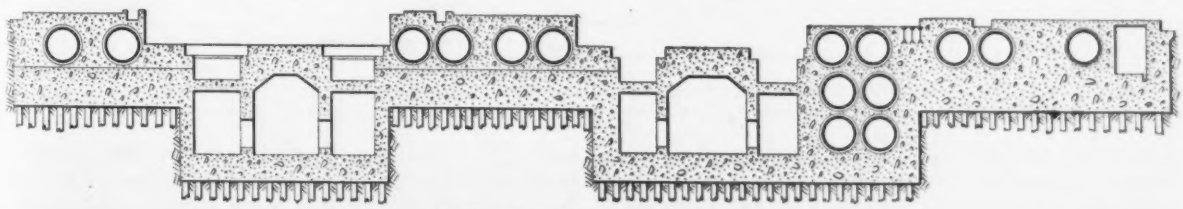


FIG. 4—SECTION OF POWER HOUSE FOUNDATION

Seven-foot reinforced-concrete mat on piles built up to nearly 15 ft. thick by concrete embedding pipes and carrying power units.

nine different plans considered that shown by Fig. 5 was chosen for its efficiency and security from interruption. The details will be given further on; in general, the plan provides (1) complete mechanical handling from aggregates and cement on scows to concrete in the forms and (2) complete command of the foundation areas by high-line chutes to masts carrying boom-line and counterweight-terminal chutes. The distribution chute and unloading derrick ranges are shown clearly by Fig. 5, which also shows volumes of concrete.

Excavating Methods and Plant—The total excavation for foundation emplacement was 90,000 cu.yd. This comprised a cut 16 ft. deep over the building sites and cut 9 ft. deep over the site. Two ¾-cu.yd. revolving shovels loaded 5-ton trucks which delivered to scows. A plank road was laid on the pit bottom and a trestle ramp to the top of the pit.

At the bottom of the first lift seepage from the river became troublesome. The several small sumps with portable pumps were supplemented by a large one located at the river end of the east lot, Fig. 3. This sump was of rather careful construction. A 13-ft. square coffer of 35-ft. steel sheeting was excavated to 7 ft. below the intake tunnels subgrade or 37 ft. below curb level and its bottom covered with 2 ft. of broken stone. On this stone mat there was centered a 10x10-ft.

box of vertical plank separated 3 in. and covered outside with wire mesh. Then the annular space between sheeting and box was filled with 7 ft. of crushed stone and the sheeting was pulled. Ditches from various directions were led to the sump and it was equipped with two 8-in. centrifugal pumps—one a stand-by pump—operated by 20-hp. electric motors.

Incidentally also seepage was restricted by cofferdamming in connection with the screen pit and intake tunnel construction. A line of 25-ft. sheeting was driven along the river front of the lot and 14 ft. inshore another line inclosing a zone of the natural bank. Also inside the cofferdams for the intake tunnels there were lines of steel pile sheeting. This and other cutoff sheet-piling for the river front structures all helped to lessen seepage into the main excavation although not intended primarily for that purpose.

The ditch and sump system took care of the east lot drainage below the first lift. For the west lot, a system of ditches led to a 3x6-ft. tunnel under Avenue D to the east lot ditches and sump. For both lots the methods described virtually eliminated hindrance from water to power-shovel work. At times the shovels, with ordinary traction wheels, had to use timber mats, and plank roads were laid for the motor trucks. There was no water hindrance of moment to shovel output. One record was 18,500 cu.yd. in 22 consecutive 8-hour working days. This was for two shovels. In one week they handled 5,745 cu.yd. The best day's output of one shovel was 151 five-yard truck loads. These records apply to the main foundation excavation. The trenches for the intake tunnels, about 13 ft. deeper and 30 ft. wide and 100 ft. and 200 ft. long, were cofferdammed and excavated by clamshells operated from derricks and from the power shovels fitted with derrick booms.

Piledriving Methods and Plant—All foundations including those for the intake tunnels and the screen pit were concrete on wood piles driven on 27 to 30-in. centers. Altogether 20,500 piles were required. They were yellow-pine 12 to 6 in. in diameter. The specifications required each pile to withstand a load of 20 tons determined by *Engineering News* formula, modified for use with a steam hammer. The contractor was required to "drive test piles to determine the length of pile necessary to meet these specifications." Tests showed that a penetration of about 30 ft. would give the bearing power required. A piledriving view is shown by Fig. 9.

Because of the close spacing, it was obvious economy to work out a driving outfit that would put down the greatest number of piles possible from one set-up and then be capable of making a quick shift. The plan worked out was two travelers on parallel trucks lengthwise of the lot. Each traveler consisted of a 28x38-ft. frame carrying two derricks, Fig. 9, with 55-ft. booms and 40-ft. steam piledriver leads. Each traveler could drive 1,100 piles from one set-up and being on wheels on track could be quickly shifted. Besides the four hammers on the travelers three standard drivers on

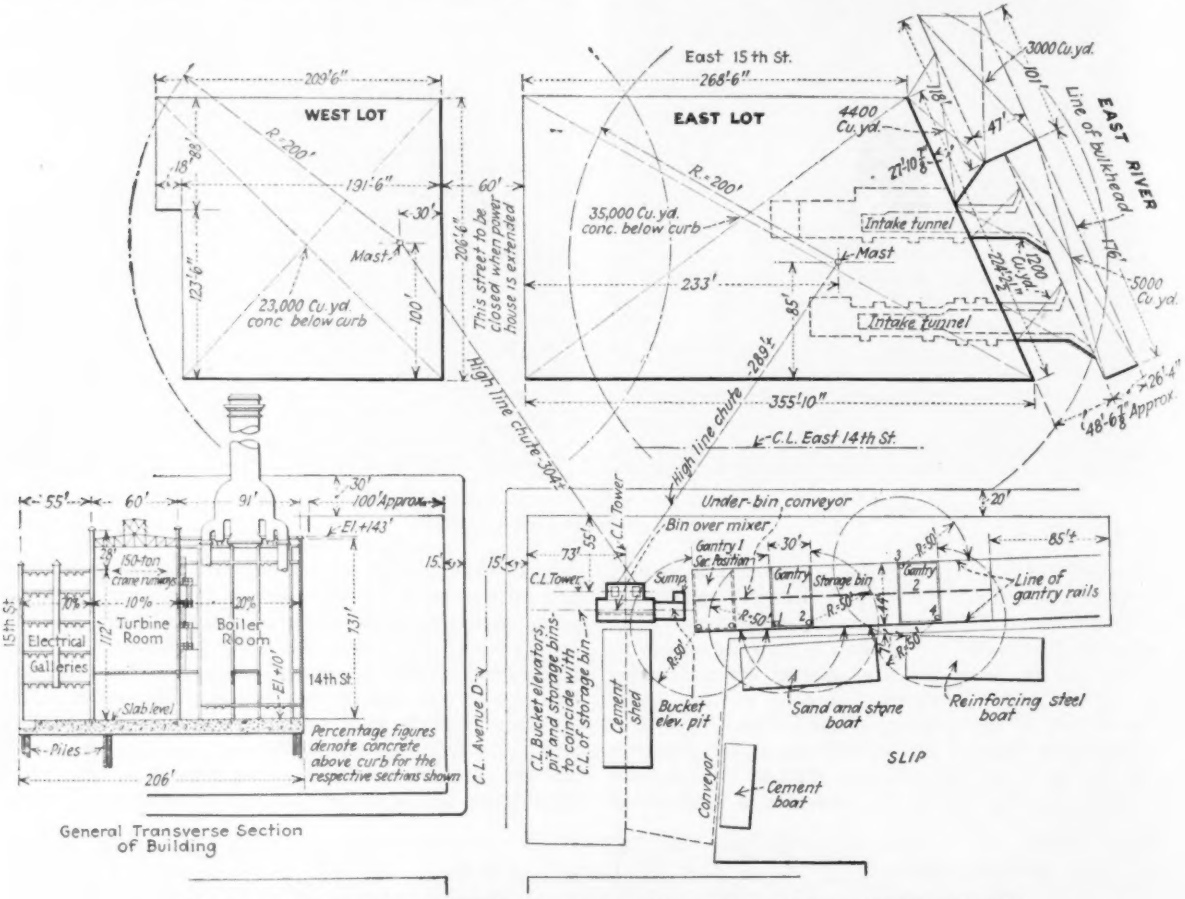


FIG. 5—DIAGRAM CONSTRUCTION PLANT LAYOUT AND POWER HOUSE SECTION
Aerial lines for concrete chutes clear power house excepting stacks. Note distribution of concrete yardage.

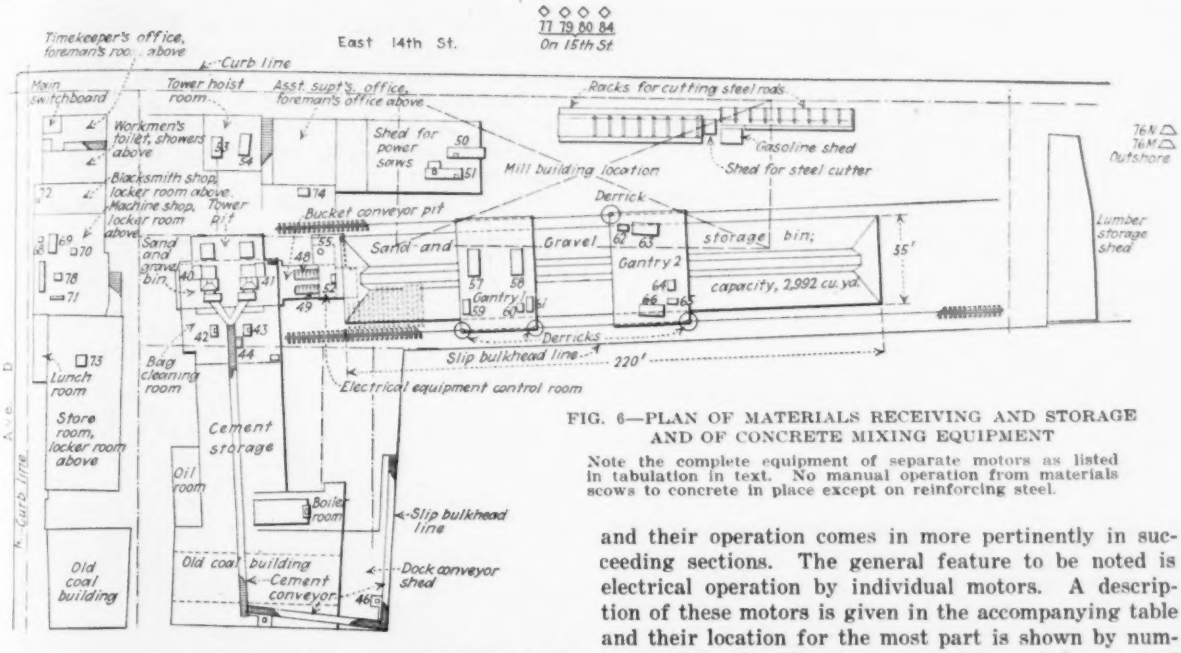


FIG. 6—PLAN OF MATERIALS RECEIVING AND STORAGE AND OF CONCRETE MIXING EQUIPMENT

Note the complete equipment of separate motors as listed in tabulation in text. No manual operation from materials scows to concrete in place except on reinforcing steel.

rollers were employed where they could be operated to better advantage than the travelers. The driving was generally rapid, each traveler hammer putting down often 80 piles a shift. The travelers also were particularly effective for unloading piles from trucks, snaking them to the leads and handling pile butts. Derrick hoist and hammer were operated from the same boiler.

Concrete Production Plant Equipment—The plant for producing concrete was designed on the assumption of 1,000 cu.yd. output a day. The location and access have been described. The layout is shown in some detail by Fig. 5. Description of the equipment units and their operation comes in more pertinently in succeeding sections. The general feature to be noted is electrical operation by individual motors. A description of these motors is given in the accompanying table and their location for the most part is shown by number on Fig. 4. There was, it will be noted, a central control room for electrical equipment; here were control switches for mixers 1 and 2, for the cement conveyor, for the conveyor under the sand and gravel bin, for bucket elevators 1 and 2, for the belt over the mixer bins, and for the gantries and sump pumps. Any operation could thus be controlled independently of the others. There were also telephone and drop indicator connection with the control room from various parts of the plant.

Handling Aggregate and Steel—Sand, gravel and 2-4 mixed aggregate were delivered on 450 to 650-cu.yd. barges which were moored to the north side of the

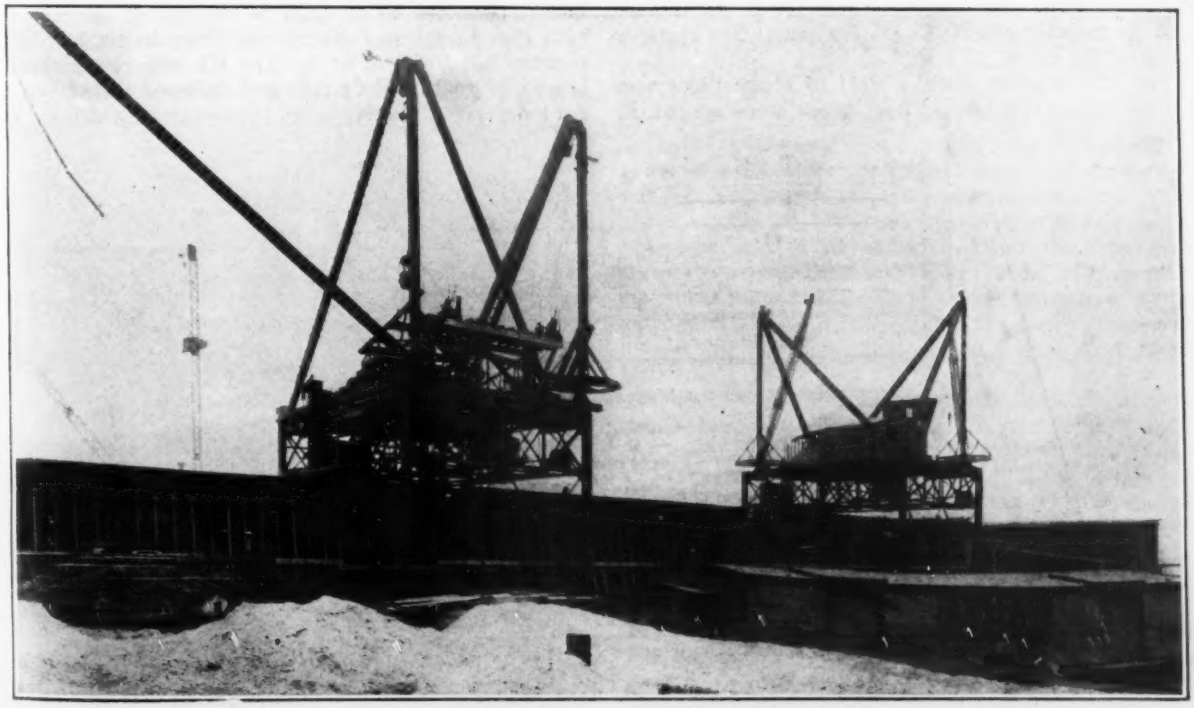


FIG. 7—STORAGE BIN AND GANTRIES FROM SIDE

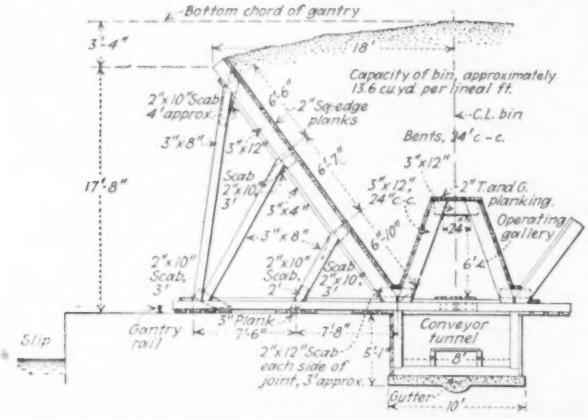


FIG. 8—CROSS-SECTION OF AGGREGATE STORAGE BIN
Note the belt conveyor tunnel and operating gallery. This bin was lined with steam pipes for heating aggregate in winter.

slip, Fig. 5. On the wharf close to and parallel to the slip side was a storage bin whose dimensions, construction and appearance are shown by Figs. 2 to 8. The bin was straddled by two gantries each having two 5-ton derricks with the boom ranges shown by Fig. 5. These derricks, with clamshells, unloaded the aggregate barges into the bins and unloaded the reinforcing rods in bundles and swung them over the bins to the north side of the pier where the cutting tables were located. The construction of the bin deserves some notice. Its walls were held by exterior bracing alone, Figs. 2 and 3. The W-section gave (1) a straight thrust of the materials against the gate openings in the sides of the inverted V and (2) a working gallery over the conveyor tunnel for the gate operator. The gates were radial 16x20 in. and spaced 7 ft. apart staggered right and left. There were 30 gates which delivered to a 30-in. belt, dished 6 in. and going to the bucket elevators to the mixer bins. The belt speed was 150 ft. per minute and the capacity was 260 cu.yd. per hour. One operator handled the gates.

For cold weather work, a grill of steam pipes was placed inside the bin. These pipes were spaced at intervals on all inside walls of the *W* and ran longitudinally of the bin. The pipe was ¾-in., perforated every 2 ft. with a needle hole. There were 4,500 ft. of pipe in the bin and some 600 ft. of branches and connections. A 125-hp. boiler furnished steam. Incidentally the same piping arrangement was used in the mixer bins.

Delivery by the under-bin belt conveyor was to two

FIG. 9—PILEDRIVING WITH TWO-HAMMER TRAVELERS

bucket elevators 50 ft. high to the top of the mixer bins Fig. 10, where delivery was direct to bin 1 or by a short belt to bin 2 or 3. The bin was rectangular, braced by yokes and tie rods and delivered to batchers. An independent frame carried the elevators, which were

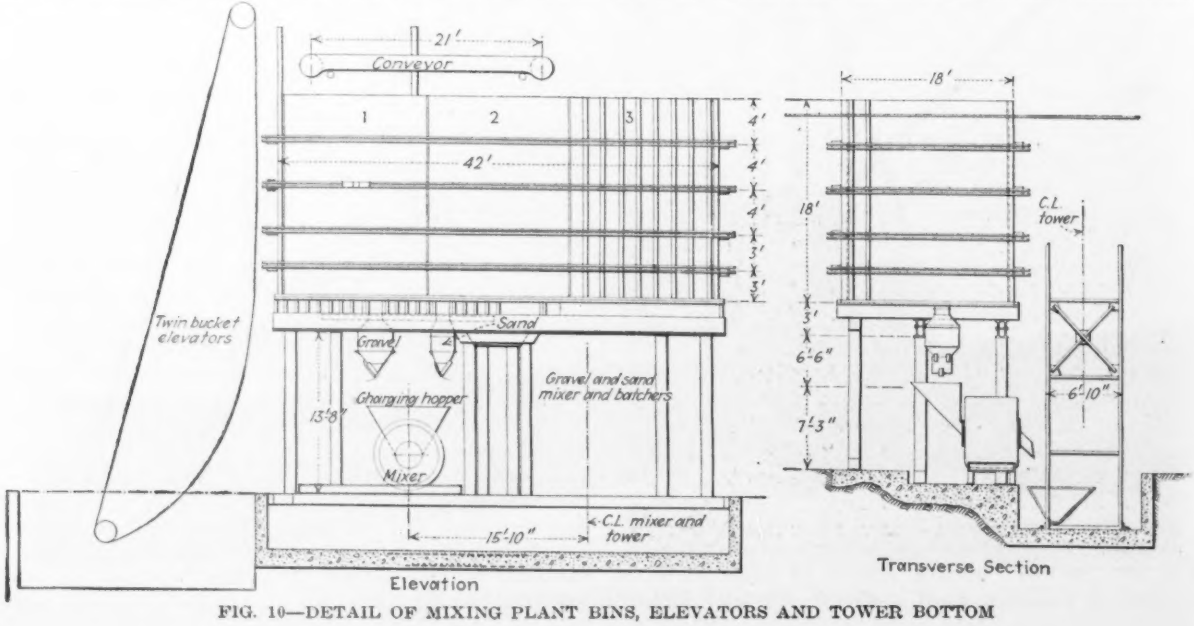


FIG. 10—DETAIL OF MIXING PLANT BINS, ELEVATORS AND TOWER BOTTOM

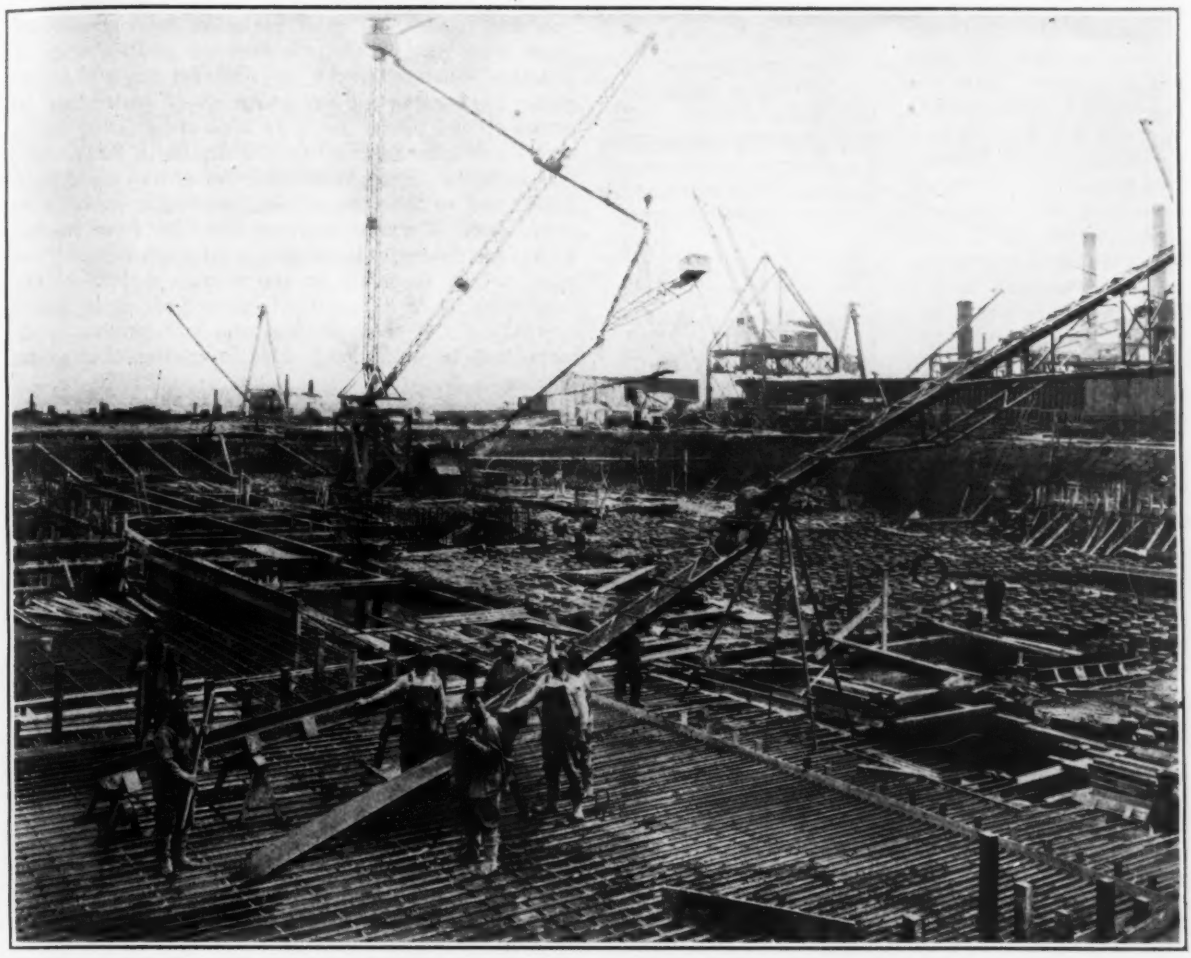


FIG. 11—CHUTE ARRANGEMENTS FOR POURING CONCRETE MAT

inclosed, ran at 97 ft. a minute, and had a capacity of 130 cu.yd. an hour.

Handling Cement—Cement in bags was delivered at the east end of the slip Figs. 5 and 6, by barges holding 8,000 to 10,000 bags. There they were unloaded onto the cement conveyor (slat type) to storage or direct to the mixer. The notable feature was direct delivery from barge to mixer. At the mixer the final section of conveyor delivered to a platform above the charging floor between which and the platform were bag chutes. The three sections of conveyors beginning at the barge had speeds of 73 ft., 87 ft. and 97 ft. With the bags spaced 8 ft. the conveyor then delivered to the mixers two 6-bag batches a minute which was the nominal rate of output of two mixers. From the mixer the cement bags went to shaking machines; the salvage was about ½ of one per cent.

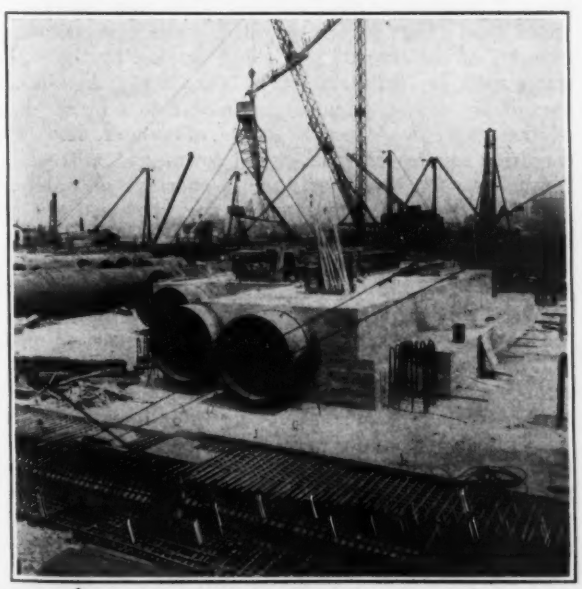


FIG. 12—DETAIL OF FOUNDATION MAT AND CONCRETE EMBEDDING PIPE LINES

Distributing Plant and Methods—A twin plant was adopted for mixing and placing concrete. Fig. 10 shows the mixer and tower location. The mixers were 1 cu.yd. machines and the towers were 240 ft. high. From each tower a high-line chute ran to a 115-ft. steel mast on a timber tower 20 ft. high. Each mast had a 100-ft. boom which carried a boom chute line and a counterweight chute with a tripod and extension chute. The plan Fig. 5 shows location and dimensions and Figs. 11 and 12 make the chuting system clear. Generally speaking the arrangement and equipment were conventional except that they embodied large tower heights and suspension chute spans. This made the erection a stiff task.

The large operations were placing the high-line chutes, which between tower and mast have a length of 289 ft. in one case and of 304 ft. in the other case. A 2,200-ft., 2-in. wire rope in one length was used for suspension cable. From No. 1 deadman outside the lot it ran to No. 1 mast head, then to No. 1 tower head, then to a ground anchorage and looped back to No. 2 tower head, to No. 2 mast head and down to deadman No. 2. Anchoring and making taut this 31 tons of wire rope was a task for hoisting engines. A strain of about 18 tons had to be put on the cable. The suspension of the chutes was by ordinary means but they were safeguarded by an inclosing wire mesh fence indicated by Fig. 13. The yokes were hung every 20 ft. and the safety ropes and wire screen kept both the chute tenders and concrete overflow from suffering or doing injury.

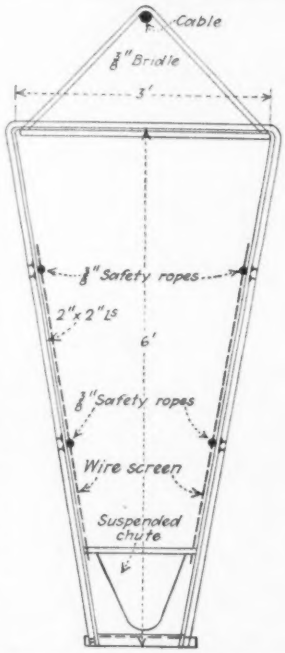


FIG. 13—CHUTE SUSPENSION AND PROTECTION

The character of the concreting task is made quite clear by the views Figs. 11 and 12. Generally the concrete was put in in 7 ft. lifts divided laterally so as to give 300 to 1,000 cu.yd. blocks. A reasonably wet mix was used. The chief variation from straightforward work was in winter concreting when changes in practice were followed. In addition to the 125-hp boiler for heating the aggregate bins a water tube hot water service heater rated to heat about 4,300 gal. of water per hour from 50 to 170 deg. with 80-lb. steam was installed. From this heater water was piped to the mixer and to the tops of the towers for washing out chute lines. Concrete in place was kept from freezing by canvas covers, salamanders and steam coils. There were only a few days in the winter of 1925-26 that concreting, with the methods described, could not be carried on and then the obstacle was protecting the placed concrete and not trouble in mixing, chuting and placing.

There were no particular problems in handling reinforcement or in form construction. A great deal of the concrete had to be put around embedded pipes but this called for only reasonable care.

Direction—The new East River station was designed and its construction is being supervised by Thomas E. Murray, Inc., New York. The general contractor is the Kenn-Well Contracting Co., New York.

EQUIPMENT USED IN BUILDING NEW YORK EDISON POWER PLANT

No.	Hp.	Use	Electric Winding	Speed R.p.m.	Drive
40M	25	Mixer No. 1	Compound	800	Gear
41M	20	Mixer No. 2	Shunt	800	Gear
42M	1	Unit Sack Cleaner No. 1	Compound	1700	Belt
43M	1	Unit Sack Cleaner No. 2	Shunt	1700	Belt
44M	10	Long Conveyor	Compound	1150	Belt
45M	10	Middle Conveyor	Compound	1150	Belt
46M	15	Dock Conveyer	Compound	1150	Belt
48M	15	Bucket Conveyor	Compound	825–1250	Gear
48M	15	Bucket Conveyor	Compound	825–1250	Gear
50M	5	Small Saw	Shunt	1700	Belt
51M	15	Large Saw	Compound	1150	Belt
52M	15	Long Belt Conveyor	Compound	825–1150	Chain
53M	100	Tower Engine No. 5	Series	600–1700	Gear
54M	100	Tower Engine No. 6	Series	600–1700	Gear
55M	1½	Sump Pump	Compound	1750	Direct
56M					
57M	65	Derrick No. 1, Gantry No. 1	Series	600–1700	Gear
58M	75	Derrick No. 2, Gantry No. 2	Series	635–1400	Gear
59M	20	Swing No. 1, Gantry No. 1	Series	800–2200	Gear
60M	24	Traveler No. 1, Gantry No. 1	Series	500–1400	Gear
61M	20	Swing No. 2, Gantry No. 1	Series	800–2200	Gear
62M	15	Swing No. 3, Gantry No. 2	Series	875–2700	Gear
63M	50	Derrick No. 3, Gantry No. 2	Series	600–1900	Gear
64M	24	Traveler Gantry No. 2	Series	500–1400	Gear
65M	20	Swing No. 4, Gantry No. 2	Series	800–2200	Gear
66M	75	Derrick No. 4, Gantry No. 2	Series	635–1400	Gear
67M	10	Steel Cutter	Compound	1150	Belt
68M	2	Emery Wheels	Compound	2050	Direct
69M	½	Pipe Threader	Compound	1700	Gear
70M	1½	Drill Press	Shunt	1700	
71M	¾	Grind Stone	Compound	1700	Worm
72M	¼	Force Blower	A.C. & D.C.	none shown	Direct
73M	15	(In storage)	Compound	1700	
73M	15	(In storage)	Compound	825–1250	
73M	5	(In storage)	2 Phase A.C.	1740	
74M	75	Air Compressor		500	Belt
75M	5	Fan-Cement Shed		1700	Belt
76M	15	Pump House		1750	Direct
76M	15	Pump House		1750	Direct
77M	10	Portable Concrete Mixer		1200–1800	Chain
78M	5	Kuick Kut Hack Saw	Shunt	550	Chain
79M	1	Pulling Murray Duets		1750	
80M	45	Concrete Tower No. 3			
81M	45	Hoist Brick Tower			
82M	15	Electric Pumps	Shunt D.C.	1750	
82M	15	Electric Pumps	Shunt D.C.	1750	
75M	5	Cement Blowers	Shunt D.C.	1700	
84M	5	Portable Pump	Shunt D.C.	1750	

Progress of Middle Rio Grande Conservancy Project

IRRIGATION, flood protection, drainage of waterlogged lands, river control and water storage and distribution are the purposes of the Middle Rio Grande Conservancy District, organized at Albuquerque, N. M., in August, 1925, as stated in the first annual report of the Board of Directors. This extensive project was noted in *Engineering News-Record* of April 1, 1926, p. 522. It is explained in the report that the river bed is rarely below and in some places is 2 to 6 ft. above the adjacent lands, while it has a tendency to widen its channel. At the same time, channel restrictions by bridges and other works have served to raise the water level, resulting in waterlogging and alkali development on certain areas.

Closely related to this condition is the flood menace, since it is expected that greater floods may be experienced than those so far recorded, while the maximum capacity of the channel was about reached by the high-water peak of 12,000 sec.-ft. in May, 1926. As a large part of the city of Albuquerque is built in a former bed of the river, floods are a source of danger, and this condition applies also to several towns and villages in the valley. On the other hand, a shortage of water is experienced at times, owing to the increased use of water for irrigation in Colorado.

On the basis of a study of the physical and topographical features, with examination of available reservoir sites, a plan is being prepared to indicate the improvements and engineering works necessary to meet the purposes of the district. It is estimated that reservoir capacity of 750,000 to 1,000,000 acre-feet will be needed, and six sites are being investigated. Water supply and silt studies are being made by the U. S. Bureau of Reclamation under an agreement with the District. Joseph L. Burkholder is chief engineer of the Conservancy District, and the Dayton-Morgan Engineering Co. is acting as consulting engineer. As Indian lands are included within the district, the advisory board includes Gen. H. F. Robinson, supervising engineer of the U. S. Indian Irrigation Service.

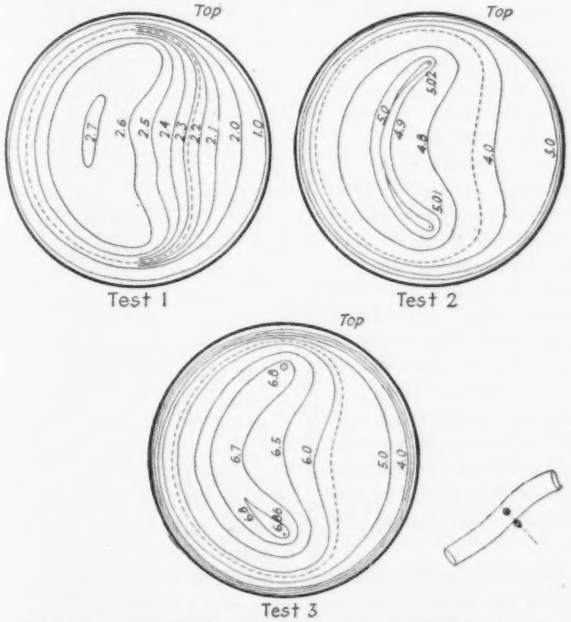
Velocity at Tangent of Curves of 36-In. Pipe

Tests Under 80-Ft. Reservoir Head Show Small Variation of Coefficient From Mean Average

By T. Farrance Davey
Civil and Mechanical Engineer, Long Beach, Calif.

THE accompanying curves are the results of a test carried out on a 36-in. reservoir discharge pipe under a head of 80 ft., at the point of tangency of two curves—one the reverse of the other. The purpose of the test was to determine the values of the coefficient—mean average velocity divided by center velocity—and to establish the supposition that on a bend the coefficient remained unchanged at different discharge rates.

A 48-in. pitometer rod was used and the main after excavation was tapped under pressure with a tapping machine and corporation cocks were installed on vertical and horizontal axes. The main was accurately calipered internally by means of special calipers and the traverses on both axes were carried out at three different rates of discharge, regulated by a valve and bypass downstream of the section under test. Carbon tetrachloride diluted with benzine to 1.2845 sp.gr. and colored with red aniline dye was used in the differential manometer for the two lowest rates of discharge, while carbon tetrachloride alone was used for the largest flow. The final results were:

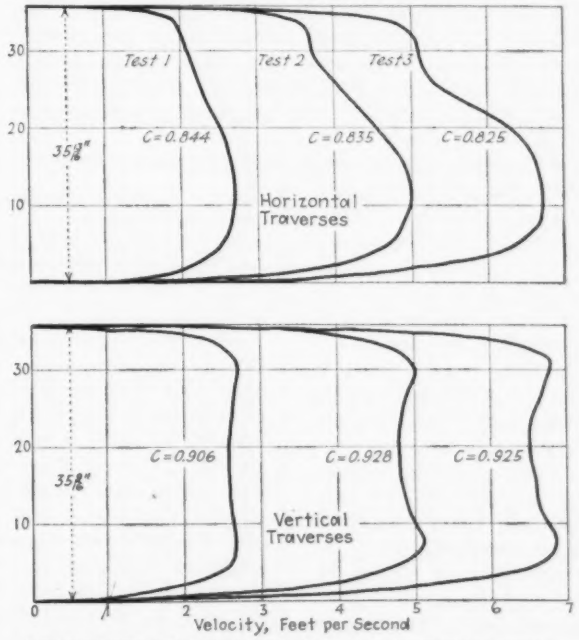


VELOCITY CONTOURS BETWEEN TANGENTS IN 36-IN. CURVED PIPE UNDER 80-FT. HEAD

Mean Velocity	Mean Coeff.	Mean of Three Tests	Deviation, Per Cent
2.28	0.875	.....	—0.228
4.23	0.880	.....	+0.34
5.71	0.875	0.877	—0.228

The accompanying velocity curves show that the variation of the coefficient from the mean average coefficient was inappreciable, being 0.33 per cent over the range of flow from 2 to 6 ft. per second.

Edward Wegmann, in his "Conveyance and Distribution of Water," quoting Weibach's experiments on loss of head in curves says: "When a reversal of curvature takes place the loss which would nominally occur in the downstream tangent of the first curve is evidently eliminated. On the other hand a loss of energy will take place on account of the sudden shifting of the position of maximum velocity with the accompanying eddy action from one side of the pipe to the other. Until experiments show what the true loss is for this case it would seem best to assume that the loss on a reverse curve is equal to that of the two separate curves."



VELOCITIES FOR HORIZONTAL AND VERTICAL TRAVERSES BETWEEN TANGENTS IN CURVED PIPE
Means of both sets: Test 1, .875; Test 2, .88; Test 3, .875. Mean for three tests, .877.

From the evidence of the velocity contours shown it is highly improbable that any sudden change of position of maximum velocity occurs in the movement of the maximum velocity from one side of the pipe to the other but that at higher velocities it breaks up into two regions of maximum velocity which unite later on the other side of the pipe to give the normal bend contours without undue eddy losses. At lower velocities the transition would take place by the contours passing gradually through straight pipe contours to their reversed bend contours.

National Forest Road and Trail Construction

During the past fiscal year, 1926, there were constructed and improved 1,930 miles of roadway and 4,694 miles of trails in United States national forests. During the same year, 11,965 miles of roads and 44,919 miles of trails were maintained. This work represents an expenditure of $11,861,560, of which $11,733,804 was obtained from funds appropriated by the federal government and $127,756 was made available by local state and county co-operators. On July 1, 1926, there was a balance of $2,829,926 available for expenditure in the funds previously appropriated and upon that day an additional $5,514,209 became available, thus making a total of $8,344,135 ready for use for road and trail construction at the beginning of this fiscal year.

Joint Board of Engineers Reports on St. Lawrence Project

Board Appointed by Canada and United States Reviews Joint Report of 1921 as to Present Cost and Feasibility—Effect of Diversions Stated and Remedial Measures Proposed—Cost Estimates Increased

THE Joint Board of Engineers appointed by the Canadian and United States governments to advise the national committees of the two governments which have been set up to advance the development of the St. Lawrence River, was given specific instructions as to what its report to these committees was expected to cover. The chief item in the instructions was that the new and enlarged Board of Engineers should review and report upon the report made in June, 1921, by the late W. A. Bowden and Col. W. P. Wooten (*Engineering News-Record*, Sept. 8, 1921, p. 402), and that it should extend its inquiries to certain additional matters with a view of supplying the technical information likely to be relevant to the proposals made in the Bowden-Wooten report to the International Joint Commission. The specific information desired of the board was put in the form of a number of questions, which, with their answers, are presented herewith in full. In addition the board reported in great detail on the various diversions from the Great Lakes and the remedial measures to protect the levels of those lakes and the physical details of the navigation and power improvement recommended. The details of these engineering reports will appear in a later issue of *Engineering News-Record*. They are contained in appendices which have not yet been published.

Joint Board Organization

In the spring of 1924 the United States Government appointed a national committee under the chairmanship of Herbert Hoover, Secretary of Commerce, designated as the St. Lawrence Commission of the United States, and subsequently the government of Canada appointed a National Advisory Committee under the chairmanship of George Perry Graham, Minister of Railways and Canals, to advise the government on matters relating to the improvement of the St. Lawrence. These two bodies agreed that the two governments should follow the recommendations of the International Joint Commission made in 1921 that a joint board of engineers representing the two countries should be constituted to review the plan formulated in the Bowden-Wooton report of 1921 and to report on additional related matters. The board as appointed consisted of Col. Edgar Jadwin (now Major General, Chief of Engineers), Col. William Kelly and Lieut. Col. George B. Pillsbury, representing the United States, and Duncan W. McLachlan, of the Department of Railways and Canals, Oliver O. Lefebvre, chief engineer, Quebec Streams Commission, and Brig. General Charles H. Mitchell, representing the Dominion of Canada.

This board made its report to the two governments on November 16. An abstract of the report is given herewith.

In general the board endorses the recommendation of the 1921 report but proposes certain changes in the location of the canals and power houses and materially increases the cost estimate as the result of its more detailed studies. As the first undertaking, the 1921 report recommended the construction of a 25-ft. channel with an initial power installation of 1,464,000 hp. in the international section of the river at an estimated cost of $252,728,000. The present report estimates that the cost of a similar channel and the initial installation of 1,365,000 hp. in the international section will cost from $350,000,000 to $385,000,000, depending on whether a single-stage development or a two-stage development of power is adopted. The 1921 report proposed a single-stage development with the main dam and power houses below Barnhart Island and a low control dam at Ogden Island. The American section of the present board favors a similar single-stage development, but with no control dam at Ogden Island, while the Canadian section favors a two-stage development. The United States section favors the single-stage development as affording better navigation by eliminating one lock and providing slightly more power at a cost of $29,600,000 less than the cost of the two-stage development, whereas the Canadian section recommends the two-stage development on the ground that it can be carried out in two parts, thus making power available in successive stages. The Canadian section also believes that the over-all cost will not be greatly in excess of that of the single-stage development because of the saving in interest costs. Also, the two-stage development will reduce the flowage of land from about 28,000 acres to 18,000 acres.

As a result of its studies of the methods of controlling the levels of the Great Lakes, the board states that it is of the opinion that it will be more desirable to construct compensating works at the outlets of Lake Huron and Lake Erie rather than regulating works, that the results to be obtained from regulating works are entirely incommensurate with their cost.

Recommendations of the Board

The plan recommended by the board for the improvement of the river will provide for a navigation route through the 183 miles of river and lake from Lake Ontario to Montreal Harbor with a total of not more than 25 miles of restricted canal navigation and not more than 9 locks. The channel will be crossed by but 8 bridges. The plan includes power houses with an ultimate installed capacity of from 2,619,000 to 2,730,000 hp. in the international section of the river, and provides for the eventual development up to an installed capacity of approximately 5,000,000 hp., which is the full power potentiality of the river. Immediate construction of power houses other than those in the international section is not recommended, but the board does recommend that navigation work be carried on with that ultimate objective in view. The estimated ex-

penditure required to provide navigation channels 25 ft. in depth and with an initial power installation of *one-half the ultimate installed capacity* of the power houses first constructed, those in the international section, is:

(1a) Total cost of improvement if with a single-stage development in the International Rapids Section (1,365,000 hp. initially installed)	$350,100,000
or	
(1b) Above improvement before channels are enlarged to ensure winter operation	337,100,000
or	
(2) Total cost of improvement if with a two-stage development in the International Rapids Section (1,365,000 hp. initially installed)	385,500,000
or	
(2b) Above improvement if the initial power installation in the International Rapids Section is all made at the lower (Barnhart Island) plants	361,600,000

After *all of the machinery* in plants recommended by the board has been installed, these costs will become respectively:

(1) If with a single-stage development of the International Rapids Section (2,730,000 installed hp.)	$394,000,000
or	
(2) If with a two-stage development of the International Rapids Section (2,619,000 installed hp.)	423,600,000

The estimated cost of additional work required to complete the full practical development of power in the river with power plants having an installed capacity of 2,500,000 hp. is approximately $225,000,000. The total eventual power installation is approximately 5,000,000 hp. and the total eventual cost of developing this power and of providing navigation with channels 25 ft. in depth is from $620,000,000 to $650,000,000, depending upon the form of improvements adopted in the international section. The 1921 report estimated the amount of power which could be developed economically at 4,100,000 horsepower.

The board estimates that the cost of improving the river for power alone with power plants similar to those recommended for the power-and-navigation improvement, with the existing 14-ft. navigation channels maintained, varies from $290,172,000 to $308,972,000, and that the cost of improving the river for navigation alone under the least expensive alternative plan is $167,720,000.

Improvements for Navigation

The plans of the board were prepared on the basis that the *interests of navigation on the St. Lawrence are paramount*. Its studies have revealed, however, that better navigation can be obtained through a combined development for power and navigation than could be obtained by a development for navigation alone, which is now economically justifiable.

The plans have been prepared on the basis that channel depths will be 25 ft. and depth over the sills of locks and other fixed structures will be 30 ft., but in view of the fact that the majority of the Canadian section favors an initial excavation to a depth of 27 ft. to correspond to the depth of the new Welland canal, estimates of the cost of providing this depth as well as the ultimate depth of 30 ft. have been included. An estimate of the economies to be made by excavating to a depth of 23 ft. to correspond to the depth in the interlake channels above Lake Erie is also included.

Power Development

In view of the rapidly increasing demand for power, the board has based its plan upon the eventual utilization of the complete power resources of the river. Its estimates are based on the assumption that the interests of navigation require that the flow in the river be maintained at a high degree of uniformity, a condition which prevents the maximum use of water for power by fluctuating the hourly flow to meet peak load demands. An installed capacity well in excess of the minimum flow of the river has been provided, however, since the increasing value of power will justify the eventual development of power which is available only during periods of high flow. The installations recommended in the international section are *less* than that proposed by private companies because of the board's opinion concerning the maintenance of a uniform flow.

Winter Operation—The board is of the opinion that the fundamental problem of winter operation will be found to be the maintenance of the discharge capacity of the river without extensive loss of head from gorging with ice rather than the local problem of handling ice at the power plants themselves. The construction of dams will create deep slow-flowing pools which are certain to freeze over in the early winter. With this condition the situation to be guarded against is the throttling of the river by the gorging of the channel at the upper end of these frozen pools. Consequently the plans for power development are based on enlarging the upper reaches of the power sections.

Diversions from the Great Lakes

The Joint Board of Engineers was asked to report upon the extent to which the levels of the Great Lakes are affected by existing diversions of water, feasible measures for raising the level of the lakes to augment the diversion and to reduce the cost of improving the lake channels, the extent to which the outflow from the lakes can be improved by manipulation of their levels and the cost of deepening the interlake channel. The board's answers to specific questions on this subject are given elsewhere in this abstract in detail.

The levels of the Great Lakes are affected by the following artificial factors: (a) The regulating work in the St. Marys River at the outlet of Lake Superior, (b) the diversion of the Chicago Sanitary District from Lake Michigan, (c) diversion from Lake Erie for power and navigation through the Welland Canal and from the Niagara River, and (d) changes in the discharge capacity of the St. Clair River at the outlet of Lake Huron and of the St. Lawrence River at the outlet of Lake Ontario. The effect of the regulating works at the outlet of Lake Superior has been to increase the low water level in that lake and diminish the high water level, and also to slightly increase the level in the other lakes. Details of the effect of the Chicago diversion are given elsewhere.

The power diversions have had a negligible effect upon the level of Lake Erie, but the navigation diversions have had some effect upon the levels of that lake and also to a small degree, the levels of Lake Michigan and Lake Huron.

Records indicate that there has been an increase in the discharge capacity of the St. Clair River which affects the level of Lake Huron but the results of the board's studies of the discharge capacity of the St. Clair-Detroit outlet as a whole have convinced it that the compensation for all channels excavated since 1901 was accomplished by depositing the excavated material so as to reduce the channel area.

TABLE I—RECOMMENDED PLANS WITH SINGLE-STAGE DEVELOPMENT IN INTERNATIONAL POWER SECTION

(a) Section	(b) Cost of Works Solely for Navigation	(c) Cost of Works Primarily for Power	(d) Cost of Works Jointly for Power and Navigation	(e) Total Cost with Complete Initial Power Installation	(f) Initial Cost if One-Half Initial Power Installation Is Deferred	(g) Complete Installed Capacity of Initial Works, Provided in Estimate Column (e) Horsepower
Thousand Islands	$1,100,000	.....	.....	$1,100,000	$1,100,000	.....
International Rapids	22,000,000	$106,500,000	$106,500,000	235,000,000	203,000,000[1]	2,326,000
Lake St. Francis	980,000	.....	.....	980,000	980,000	.....
Soulanges	31,594,000	37,665,000	34,686,000	103,945,000	92,000,000	404,300
Lachine	53,000,000	.....	.....	53,000,000	53,000,000	.....
Total	$108,674,000	$144,165,000	$141,186,000	$394,025,000	$350,080,000[1]	2,730,300

[1] Including $13,000,000 for channel enlargement to assure winter operation.

Compensating and Regulating Works—The board states that the levels of the Great Lakes can be raised by works in their outlets which may be wholly in the form of fixed weirs and contractions or may be provided with sluice gates. The first of these have come to be termed compensating works and the second are termed regulating works. Regulating works for Lake Ontario are part of the plan for the improvement of the St. Lawrence River and regulating works already exist on Lake Superior. There remains then only the determination of what type shall be used, if any, at the outlets of Lake Huron and Lake Erie. The board states that after careful study, it has turned to compensating works in the outlets of Lake Huron and Lake Erie only after it was found that results that can be secured from regulating works are entirely incommensurate with their cost. The chief limitation upon Lake regulation is that it is the excess discharge during low water periods that furnishes the bulk of the flow of the Niagara and St. Lawrence rivers, that there have been times when practically all of the water flowing out of the lake came from the recession of lake levels. Consequently the lake levels must be permitted to recede in order to maintain the flow of the river. On the other hand, the lake levels cannot be raised materially in order to hold back flood flow without doing great damage by raising the lake levels above the established high water mark.

Regulation for Navigation—Considering only improving the lake levels for navigation, the minimum *regulating work* necessary to gain increase in head would cost $36,400,000. The cost of securing the same improvement in lake channels and harbors by *compensating works* and supplementary dredging is placed at $13,400,000. From this it is clear that the construction of regulating works for the benefit of lake navigation is not economically justified. Moreover, the board points out that regulation works in the St. Clair River would be a great burden upon the intensive water traffic and would result in an aggregate economic loss of $1,000,000 per annum.

Regulation for Power—In order to see whether regulation was justifiable for the purpose of increasing the flow for power on the St. Lawrence, the board made a study with that end in view and concludes that no program of regulation would materially increase the total output of plants with an installed capacity sufficient to utilize the mean flow of the river, and states that the advisability of undertaking regulation depends wholly on the nature of the market for power that may develop, that the regulation of Lake Ontario alone will afford sufficient control until at least the enormous amount available without further regulation is absorbed. In this connection the board points out that as the predominant interests concerned in the levels of the Great Lakes are in the United States and the predominant interests concerned with the outflow into the St. Lawrence are in Canada, lake regulation might be a point of difference between the various interests in the two countries.

Compensating Works—The investigations of the board show that it is advisable to construct compensating works in the Niagara and St. Clair rivers to counteract the effect of all diversions and outlet enlargements on the levels of Lake Michigan, Huron and Erie.

Compensating works to counteract *only* the effect of authorized diversions covered by licenses are estimated to cost: For the Chicago Sanitary District diversion $400,000 in the Niagara River, and $1,350,000 in the St. Clair River; and for power diversions on the Welland canal, $100,000 in the Niagara River.

Deepening Channels—An uncompensated enlargement of the navigation channels through the St. Clair and Detroit rivers would tend to lower the levels of Lake Michigan and Lake Huron. On the Detroit River enlargement can be compensated by the deposit of the excavated material. On the St. Clair River some additional compensating work will probably be required. The cost of these to counterbalance the excavation of the channel to a depth of 25 ft., is estimated at $200,000.

The cost of improving the channels between Lake Erie and Lake Superior to secure a depth of 25 ft. below the levels available 99 per cent of the time during navigation season, after compensating works have been constructed, is placed by the board at $3,600,000 for

TABLE II—RECOMMENDED PLANS WITH TWO-STAGE DEVELOPMENT IN INTERNATIONAL POWER SECTION

(a) Section	(b) Cost of Works Solely for Navigation	(c) Cost of Works Primarily for Power	(d) Cost of Works Jointly for Power and Navigation	(e) Total Cost with Complete Initial Power Installation	(f) Initial Cost if One-Half Initial Power Installation Is Deferred	(g) Complete Installed Capacity of Initial Works, Provided in Estimate Column (e) Horsepower
Thousand Islands	$1,100,000	.....	.....	$1,100,000	$1,100,000	.....
International Rapids	33,481,000	$140,209,000	$90,656,000	264,546,000	238,400,000[1]	2,215,000
Lake St. Francis	980,000	.....	.....	980,000	980,000	.....
Soulanges	31,594,000	37,665,000	34,686,000	103,945,000	92,000,000	404,300
Lachine	53,000,000	.....	.....	53,000,000	53,000,000	.....
Total	$120,155,000	$177,874,000	$125,542,000	$423,571,000	$385,480,000[2]	2,619,300

[1] This becomes $214,500,000 if installation is at Barnhart Island powerhouses.
[2] This becomes $361,580,000 if initial installation in International Rapids Section is at Barnhart Island powerhouses.

compensating works, and $41,100,000 for the cost of excavation. The Welland Canal when completed will give this depth of 25 ft. between Lake Erie and Lake Ontario.

The board finds that a saving of $1,250,000 can be effected by including compensating works in providing for 25-ft. channel depths rather than by securing the depth by dredging only. Such work will afford increased depth in all harbors on Lake Michigan, Huron and Erie. The construction of compensating works is therefore fully justified.

The field work upon which this report is based was a continuation of the work of the board which reported to the International Joint Commission in 1921. The Canadian Department of Railways and Canals, having these data, continued the work in 1922 and 1923. After the appointment of the new board the Canadian section continued these investigations. The United States section devoted its time mainly to investigating the dam sites in the international section. The two sections together made upwards of 400 borings. Each section employed an extensive engineering force in field and office. The United States section engaged the firm of Viele, Blackwell and Buck as consulting engineers on features relating to power development. Other sources of information were reports of the U. S. Board of Engineers on Deep Waterways of 1900, the Georgian Bay Canal Survey of 1908, also data supplied by power companies operating on the river and the Ontario hydro-Electric Power Commission.

The Board Answers Specific Questions

The instructions to the board of engineers contained eleven specific questions which it was asked to answer. These questions and the answers of the board are given below:

Question 1—Is the scheme for the improvement of the St. Lawrence waterway, presented by the board in its report of June 24, 1921 (herein referred to as the Report of 1921), practicable and does it provide to the best advantage, at this time and ultimately, for the development of the capacities and possibilities of the waterway?

Answer—The scheme as presented in the Report of 1921 is in its broad lines practicable, but should in the opinion of this board be modified to provide the best present advantage, at this time and ultimately, for the development of the capacities and possibilities of the waterway.

Question 2—What alternative scheme, if any, would be better adapted to secure the ends desired, due consideration begin given: (a) To any special international or local interests having an importance justifying exceptional consideration; and (b) to the extent and character of the damage through flooding and the probable effect of the works upon the formation of ice and the consequent effect on the flow of the river?

Answer—The plans presented in the Report of 1921 are altered in their broader features as follows:

In the International Rapids Section (Fourth Division of the Report of 1921) the plans now presented provide for the development of the entire power possibilities of the section, without subsequent alterations in the works. Two alternative schemes for accomplishing this result are presented, one for a two-stage development, the other for a single-stage development.

In the Soulanges Section (Second Division) the board recommends a scheme for navigation correlated with a progressive development of power instead of a side canal for navigation only.

In the Lachine Section (First Division) the alignment of the navigation canal is changed to secure a minimum interference between land and water traffic, and a control dam to regulate the levels of Lake St. Louis has been included in the initial development.

The plans proposed have been drawn with full regard to all interests concerned. Flowage damage is inseparable from a practicable development of power on the St. Lawrence, since freedom from floods has led to the occupation of its banks almost to the water's edge. The plans have been drawn to reduce to a minimum the flowage consequent to the plans proposed. They have been prepared with special care to meet ice conditions affecting the flow of the river.

Question 3—Should the estimate of cost be revised, and, if so, what are the revised estimates of cost having regard to alternative schemes?

Answer—The estimates should be revised. The estimates of the works proposed by this board, with hydro-electric machinery completely installed, exclusive of interest during construction are:

(1) If a single-stage development be adopted in International Rapids Sections

Works solely for navigation	$108,700,000
Works common to power and navigation	141,200,000
Works primarily for power	144,100,000
Total	$394,000,000

Installed capacity 2,730,300 hp.

(2) If a two-stage development be adopted in International Rapids Section

Works solely for navigation	$120,200,000
Works common to power and navigation	125,500,000
Works primarily for power	177,900,000
Total	$423,600,000

Installed capacity 2,619,000 hp.

The board considers that sound business management will dictate the initial installation of but a part of the hydro-electric machinery with its housing and accessories. With a total initial installation of 1,368,000 hp. the initial costs, including all features required for navigation and with complete channel enlargement for winter power operation, become respectively $350,100,000 and $385,500,000.

The plans presented by the board outline a subsequent complete development of the power resources of the river, by the construction of additional power works with an installed capacity of approximately 2,500,000 hp. at an additional cost of approximately $225,000,000.

The total ultimate development visualized on the St. Lawrence River by the board amounts therefore to approximately 5,000,000 hp. at a total cost of from $620,000,000 to $650,000,000, including navigation works.

Question 4—In order to assist either Government to allocate the amounts chargeable to navigation and power, what would be the respective estimated costs for improving the river for navigation alone and for power alone?

Answer—The estimated costs for the initial improvement of each river section, (a) on plans recommended by the board for both power and navigation, (b) on similar plans for the development of the same amount of power without any navigation works other than to maintain the existing 14-ft. navigation, and (c) on alternative plans for practicable, though inferior, navigation through the power sections, are shown in parallel columns as follows:

(1) If a single-stage development is adopted in the International Power Section:

Section	(a) Plans Recommended	(b) Power Alone	(c) Navigation Alone
Upper International	$1,100,000	.....	$1,100,000
International power	235,000,000	$213,000,000	79,000,000
Lake St. Francis	980,000	77,172,000	980,000
Soulanges	103,945,000	.....	33,640,000
Lachine	53,000,000	.....	53,000,000
Total	$394,025,000	$290,172,000	$167,720,000

(2) If a two-stage development is adopted in the International Power Section:

Section	(a) Plans Recommended	(b) Power Alone	(c) Navigation Alone
Upper International	$1,100,000	.....	$1,100,000
International Power	264,546,000	$231,800,000	79,000,000
Lake St. Francis	980,000	77,172,000	980,000
Soulanges	103,945,000	.....	33,640,000
Lachine	53,000,000	.....	53,000,000
Total	$423,571,000	$308,972,000	$167,720,000

Effect on Lake Levels

Question 5—To what extent may water levels in the St. Lawrence River at and below Montreal, as well as the river and lake levels generally, be effected by the execution of the project?

Answer—The irresponsible operation of the power works proposed by the board, or indeed of any power works, however designed, that develop fully the power resources of any section of the river, would affect injuriously the water levels in the St. Lawrence River at and below Montreal; but it is feasible to operate these works under government supervision in such manner that they will neither lower the summer levels in the lower river nor raise the winter and spring levels. With such control the improvements proposed will have no injurious effect whatever on the water levels of the St. Lawrence at and below Montreal.

The high levels of Lake Ontario, of the upper reaches of the St. Lawrence River, extending 67 miles from that lake, and of Lake St. Francis and Lake St. Louis, will not be raised by the improvement. The low levels of Lake Ontario and of these upper reaches of the St. Lawrence will not be made lower. The low levels of Lake St. Francis will be raised about a foot and of Lake St. Louis about 5 feet. The dams proposed in the power reaches of the St. Lawrence will create material local changes in the levels of these reaches only.

The levels of the Great Lakes above Lake Ontario cannot be affected by any works in the St. Lawrence proper. Works to restore the effects of channel enlargements and of diversions from lakes above Lake Ontario, are dealt with under the replies to Questions 6 (b) and 10.

Question 6 (a)—To what extent and in what manner are the natural water levels in the St. Lawrence River and on the Lakes affected by diversions authorized by license by either Canada or the United States from or in the St. Lawrence River watershed?

Answer—The diversion by the Chicago Sanitary District of 8,500 sec.-ft. from the lake basin through the Chicago Drainage Canal, authorized by license by the United States, lowers the water levels on the Great Lakes and the St. Lawrence River as follows:

	Fee
Lakes Michigan and Huron	0.5
Lake Erie	0.4
Lake Ontario	0.4
St. Lawrence River between Lake Ontario and Montreal	
At Prescott	0.4
At Lock 25 (Iroquois)	0.6
At Lock 23 (Morrisburg)	0.5
At Lock 21 (Dickensons Landing)	0.4
At Lock 15 (Cornwall)	0.3
Lake St. Francis	0.2
Lake St. Louis	0.3

St. Lawrence River at and below Montreal:

	Feet
At Montreal Harbor	0.37
At Varennes	0.35
At Sorel	0.28
At Batiscan	0.24
At Lotbiniere	0.24
At Platon	0.17
At Quebec	0.03

The diversion of 2,080 sec.-ft. from Lake Erie via the Welland Canal for power use by corporations and municipalities authorized by license by Canada lowers the levels of the Great Lakes as follows:

	Feet
Lake Michigan and Huron	0.025
Lake Erie	0.1

The foregoing are the only authorized diversions found by the board to affect appreciably the levels of the Lakes and the St. Lawrence.

Question 6 (b)—By what measures could the water levels or navigable depths affected by the diversions referred to in section 6 (a) be restored, and what would be the cost thereof?

Answer—The water levels of Lakes Michigan, Huron, and Erie can be restored most advantageously by compensating works in the St. Clair and Niagara Rivers, which should, however, be so designed as to offset all existing diversions and outlet enlargements, as well as the diversions authorized by license. The total cost of these works is estimated at $3,400,000. The cost of similar but less extensive works designed to restore the effect of authorized diversions only is estimated as follows:

Diversion compensated for	Cost of Works
Chicago diversion	$1,750,000
Power diversions, Welland Canal	100,000

The effect of the Chicago diversion on the levels of Lake Ontario and of the St. Lawrence River above Montreal will be removed by the works provided for the improvement of this part of the St. Lawrence.

The effect of the Chicago diversions on the levels of the St. Lawrence River at and below Montreal can be restored by dredging and accessory works at estimated costs as follows:

Dredging Montreal Harbor	$654,000
Reconstruction of Dock Walls, Montreal Harbor	1,800,000
Dredging below Montreal	2,154,000
	$4,608,000

Question 6 (c)—How much power could be developed on the St. Lawrence River with the water diverted from the watershed referred to in sections 6 (a) under—

(1) The plans recommended?

(2) Alternative plans providing for a full practicable development of the river?

Answer—The following amounts of 24-hour power could be developed on the St. Lawrence River with the authorized diversion of 8,500 sec.-ft. from the watershed through the Chicago Drainage Canal:

(1) At the average heads available at the power plants initially recommended—

	Horsepower
In the International Power Section (82.5-ft. average head)	70,125
In the Soulanges Section (22-ft. average head)	18,700
Total	88,875

(2) At the average heads available at the power plants recommended for the eventual full practicable development of the river—

In the International Power Section (82.5-ft. average head)	70,125
In the Soulanges Section (75-ft. average head)	63,750
In the Lachine Section (32-ft. average head)	27,200
Total	161,075

Question 6 (d)—Without considering compensation by the present relative diversions of water from the Niagara River and from Lake Erie, and without prejudice to a future consideration thereof, what works, if any, could be constructed to recover on the St. Lawrence River the amounts of power determined under section 6 (c), and what would be the cost of such works?

Answer—The board finds that after the St. Lawrence River has been fully developed for power production, no works can be constructed which would recover on the St. Lawrence the power lost by the diversion of water from the watershed.

Supervision of Construction

Question 7—Having regard to economy of construction and maintenance, expedition of construction, and efficiency of operation—

(a) Which of the works should be constructed under the technical supervision of an international board and what other works, if any, might advantageously be constructed under such supervision?

(b) Which of the works should be maintained and operated by an international board and what other works, if any, might advantageously be so maintained and operated?

Answer (a) Construction of Works—All dams, embankments, power house substructures, water passages, gates and channel enlargements within the International Sections should be designed and constructed under the technical supervision of a single international authority. The purpose of this is to make sure that the different parts of the works will not be so prosecuted as to interfere with each other, and that safe and equitable regulation of both winter and summer flows of the river will be possible both during and after construction; as well as to secure uniformity, economy and expedition by co-ordinating design and construction programs. The same authority should co-ordinate for the entire river, from Lake Ontario to Montreal, the programs of construction and the channel dimensions and clearances for works necessary to secure through navigation.

(b) Maintenance and Operation of Works—The board regards it as essential that an international control board be created with full power to regulate the use of water at the power plants in the International Section in order that such use may be prevented from creating conditions harmful to navigation in any part of the St. Lawrence, and in order that the operation of the various power plants be conducted with full regard to the use of water at other power plants on the river.

All locks and other navigation structures will necessarily lie in the territory of one country or the other, and can be most advantageously maintained and operated by the usual government agencies of the two countries.

CHANGES IN INTERNATIONAL BOUNDARY

Question 8—What, if any, readjustments in the location of the international boundary are necessary or desirable to place power structures belonging to either country within its borders, as recommended by the International Joint Commission?

Answer—Readjustments in the international boundary are necessary only in the International Rapids Section and depend upon the plan adopted for the improvement there.

A change in the boundary in the vicinity of Barnhart Island is necessary irrespective of whether the single-stage or the two-stage scheme be adopted in this section. If, with either of these general schemes, the dam is located at the foot of Long Sault Island and both power houses at the foot of the island, as shown on the plans of the two-stage development, a change is necessary to bring the power houses within the borders of the two countries. If, on the other hand, the dam and power houses are at the foot of Barnhart Island, with the United States power house on the mainland of the United States, as shown on the plans of the single-stage development, it is desirable to so change the boundary as to bring all of Barnhart Island into Canadian territory. This island is separated from other American territory by the main channel of the St. Lawrence. The estimates include the acquisition of the entire island in connection with power development, and the land remaining unsubmerged can, with this plan, be put to beneficial use only in connection with the Canadian power house located thereon.

With the two-stage scheme, a slight change is needed also in the boundary north of Ogden Island, to bring the power houses there within the borders of the respective countries.

Question 9—If the board is of the opinion that it would be advantageous to provide in the first instance for channel depths other than 25 ft., but less than 30 ft., for what draft of vessel should provision be made?

Answer—The board is not agreed on the advantage of any depth other than 25 ft.

Question 10—Having regard to the recommendation of the International Joint Commission that the new Welland Ship Canal should be embodied in the scheme and should be treated as a part thereof, and to the fact that if a greater depth than 21 ft. be adopted for the initial project depth of the St. Lawrence, such greater depth would not be available to the upper lake ports without further work in the navigation channels in the Lakes, what would be the cost of improving the main navigation channels between and through the Lakes, so as to provide, without impairing the present lake levels, for (a) a depth of 25 ft. and (b) such other depth, not exceeding 30 ft., as may be determined by the board to be that for which it would be most advantageous to provide on the St. Lawrence River?

Answer—The cost of improving the main navigation channels between and through the Lakes, so as to provide a depth of 25 ft., including all compensating works constructed in furtherance of the work, is estimated at $44,700,000, not including the cost of the new Welland Ship Canal.

Question 11—What is the time required to complete the proposed works, the order in which they should be proceeded with, and the progress which should be made yearly toward the completion of each in order to secure the greatest advantage from each of the works and from the development of the waterway as a whole?

Answer—It is estimated that the waterway can be opened to navigation in from seven to eight years from the time that active work has been begun. All works should be so prosecuted as to insure the completion of navigation works at the same time. A complete program for the prosecution of the work will be presented in Appendix G.

Toll Bridges Attacked in Resolution of State Highway Officials

A STRONGLY worded resolution against toll bridges, more particularly privately owned toll bridges, was adopted by the American Association of State Highway Officials at its annual meeting two weeks ago. The resolution declares that the rapidly increasing number of private toll bridges at strategic stream crossings has become a matter for serious concern, that states cannot control their erection and operation in view of wide-open special acts of Congress, and that the erection of private toll bridges on the public highways should no longer be tolerated. It follows with these major paragraphs:

"Although recognizing that in some instances involving the erection of large bridge structures at costs in excess of the public funds which reasonably may be applied thereto the construction and operation of such structures as toll bridges may be justifiable, it is nevertheless the sense of this association, first, that in each such case the bridge should be built, owned and operated by the state or its political subdivisions and the tolls applied to amortizing or reimbursing the cost thereof, after which such tolls should be abolished, and second, that in no such case should the bridge be built, owned and operated as a private toll bridge unless the state or its political subdivisions should not be in position to finance its construction and operation, and that with respect to private toll bridges so to be erected the law of Congress authorizing the same should provide, among other things, that from the standpoint of the highway traffic the location, design, plans and specifications, contract, the actual construction work, the regulation of traffic and the tolls to be charged for or on each such bridge wholly within one state shall be subject to approval by the proper authorities of such state, and in the case of any such bridge between two or more states such approval should be by the proper authorities of all such interested states, or should be by such federal agency as Congress may designate in the event of disagreement or inability or failure on the part of such interested states or any of them to give such approval, and that no tolls may legally be collected from traffic over such private structure unless the approval so required shall have been obtained.

"Each authorization for the construction of private toll bridges on public highways should limit the tolls that may be collected to not exceed such as will meet the actual necessary operating and maintenance costs and yield a prescribed reasonable annual return on the actual cost of the bridge; any amount in excess thereof which the tolls charged may yield should be deposited in a special trust fund and be available for use by the state or its political subdivisions in acquiring such privately owned toll bridge; the state or its political subdivisions should be given the right and the power to acquire such privately owned toll bridge at any time from the date such bridge is opened to traffic and on a basis that will be fair alike to the owners and to such state or its political subdivisions."

Field Welding Experience on 65-In. Mokelumne Pipe

Both Gas and Electric Methods Used in Joining Pipe for New East Bay Water Supply in California—Internal Stresses in the Metal Led to Change to Riveted Field Joints

By Arthur P. Davis
Chief Engineer, East Bay Municipal Utility District

In laying the 65-in. steel pipe line which is now being built as part of the Mokelumne water supply project for the East Bay Municipal Utility District in California, about 26,000 ft. of the line, at the outset of the work, was connected up by butt-welded circumferential joints made in the trench. Before this length of the line had been completed it was evident that satisfactory field welds could be made only with great difficulty and even after ample time for organization and a considerable amount of experience with all field conditions a considerable percentage of the field joints had to be done over.

It was then decided that a change to riveted butt-strap joints was justified and this was accordingly ordered, as reported in *Engineering News-Record*, May 27, 1926, p. 874.

WELDING IN PROGRESS ON MOKELUMNE PIPE LINE
Welder at left is standing on ladder. Note slotted plates and wedges holding together the edges to be welded.

Fundamentally, the reason for the change was that with the methods used on this job the large diameter of the pipe seemed to make it very difficult to equalize temperatures so as to avoid internal stresses in the metal plates. The longitudinal electric welds, made under shop conditions with equipment and methods quite different from those applied in the field, have been able to pass severe pressure and hammer tests and to date have been satisfactory to the district both in quality and speed of production.

The following notes were prepared with a view to putting on record the experience and observations in connection with the field welding that might be of value to other engineers. An article on the electric shop welding of the longitudinal seams in this pipe appeared in *Engineering News-Record*, July 22, 1926, p. 128.

When bids were received for the construction of the first unit of the Mokelumne pipe line, this unit being 86 miles long, it developed that a saving of over $4,000,000, or 30 per cent of the total amount of the contract, could be made by using welded joints in both shop and field. It was decided to take advantage of this saving, but in drawing up plans and specifications and because in pipe of this large diameter with thicknesses as much as ½ in. there was no previous experience to serve as a guide, the contract was so phrased that in the event the welding, either in shop or field, was not adjudged satisfactory, the district could at any time require the contractor to substitute riveting for the welding at an increase in the original contract price. This increase was to be 40 per cent of the difference between the bid prices of welded and riveted pipe.

When field work on this pipe line began, the 30-ft. sections of the pipe were delivered by barge, 36 sections to the barge load, via Suisun Bay and the San Joaquin River to the lower end of the pipe trench. Here the sections were unloaded by floating derricks directly onto trucks that delivered them along the trench. After being laid in the trench, adjoining ends of the pipe sections were drawn up by steel wedges and slotted plates and tack welded, being held thus firmly in position ready for butt welding.

On the outside of the pipe the oxyacetylene process was used, two welders usually working simultaneously on a joint. As the welding progressed the wedges used to hold the sections together were knocked out or, if the movement of the pipe under the heat of welding prevented their being removed with a hammer, the wedges were cut out with the oxy-torch.

After completing the external weld an electric arc was used on the inside to supplement or "back up" the external weld and to insure proper fusion of the internal edges of the adjoining plates. The oxyacetylene process could not be used on the inside on account of the heat and gases it generates and the difficulty of securing adequate ventilation to dissipate these. Physical and microscopical examinations indicated that the electric weld on the inside of the joints improved the condition of the oxyacetylene weld, having the effect of normalizing it and increasing its tensile strength.

Heat Expansion Difficulties—The oxyacetylene welding being a rather slow process caused much expansion of the pipe metal and introduced unequal internal stresses in different parts of the circumference. These stresses were sufficient in numerous cases to cause the

TRENCH PARTIALLY BACKFILLED, JOINTS LEFT EXPOSED
This reduced to a minimum movement of pipe due to temperature range and left joints accessible.

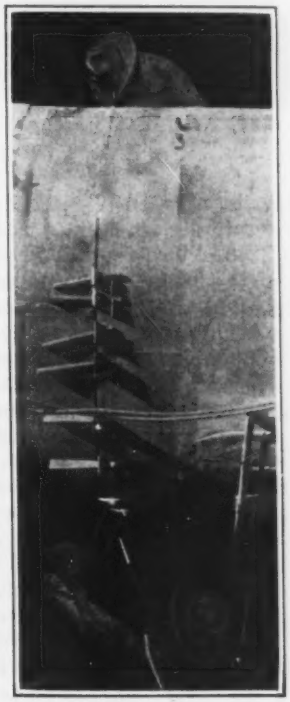
joints to crack open as the completed weld cooled. For example, with adjacent edges to be welded spaced about ¼ in., welding could proceed only a short distance before expansion due to the heat of welding had closed this space ahead of the weld and caused a compressive stress between the abutting plates sufficient in many cases to cause overlapping. This condition resulted in the almost continual necessity for cutting out pieces of the plate ahead of the weld in order to make progress possible.

Under these conditions wide irregularity of stress occurred in the metal at the joints due to temperature differences, despite every effort to compensate for the heating and the normal movement of the pipe plates by the use of different widths of opening between plates before welding began. As an extreme instance it might be cited that in attempting to complete a 2-ft. length of weld which happened to have the unusual width of 1 in. at the far end, it was found that before the weld had been completed this 1-in. gap had closed up tightly and some of the plate had to be cut out before the weld could be finished. This indicates the serious nature of internal stresses after the welded joint cooled. The large diameter of the pipe prevented any approach to uniformity of temperature around the entire circumference as the welding proceeded.

Another difficulty was due to the temperature differences caused by the necessity of laying the pipe in the summer time with the heat of the sun warming its upper surface. Differences of 80 deg. F. between the temperature of the top of the pipe and the temperature of the metal in contact with the bottom of the trench were observed. That is, when the bottom of the pipe had a temperature of about 60 deg. F. the top of the pipe exposed to the sun would have a temperature of about 140 deg. F. The conditions at night were reversed, that is, the top of the pipe exposed to the cool night air was cooler than the metal in the bottom in contact with the ground.

To compensate for this temperature difference as the welding progressed portions of the plate at the top of joints had to be cut out. This had its bad effect, however, in that when the pipe cooled there was tension along its top greater than elsewhere on the circumference. In one instance where a circumferential weld broke from shrinkage this greater internal stress in the top of the line was sufficient to raise the released ends of the pipe 3 or 4 in. off the bottom of the trench.

Due to operating delays in the field the electric welding inside the pipe at one time got considerably behind the external oxy-acetylene welding. Under these conditions a considerable number of joints on which only the external welding had been done cracked open due to internal stresses in the metal. For the most part the breaks occurred in the early morning when the pipe was at its lowest temperature. Oxyacetylene welds that had been backed up by electric welds were not subject to cracking. In a few cases where the electric welding was for some reason not carried entirely around the circumference, the external weld cracked for that portion of its length on which the electric weld was lacking.



MAKING EXTERNAL OXYACETYLENE WELD
Note welder below working up. Downward welds were avoided. Many wedges were often required.

Where welds cracked and the joints pulled apart the remedy was to cut out a section of the pipe about 30 in. long and substitute a short section or filler that had joints welded at both ends, thus putting in two circumferential welds in replacing the one that had cracked. As an aid to placing these fillers a type of gallows-frame was made up of standard 2-in. pipe in the shape of a tripod with its top spread to take a short horizontal bar and two of the legs set at right angles to that bar. The lower ends of these two legs were shod with steel plates curved to fit the surface of the pipe. The frame was steadied by tipping it slightly toward one side so as to put part of the weight on a third leg consisting of a pipe extending from the horizontal bar into the spoil bank on one side of the trench. Fillers were placed in position by means of a chain block from the gallows-frame, hooked into a small perforated plate welded to the top of the filler.

The original design of the pipe line did not include any expansion joints because it was expected that the trench would be backfilled immediately after the sections had been welded. However, due to the necessity for inspection of joints and delays incidental to making repairs the pipe was not backfilled as a whole but a part of the fill was placed on the middle of each section in the endeavor to decrease expansion and contraction movement as much as possible.

Change to Riveting and Lap Welding—Various schemes were tried to take care of the expansion and

TYPICAL BREAK IN EXTERNAL CIRCUMFERENTIAL WELD
When not backed up by internal welds the external welds sometimes gave way under low temperatures.

contraction in the trench due to atmospheric temperature changes. At first every tenth joint was left open. When it was found that a considerable number of the joints still pulled apart the plan was changed to leave every third joint open. This did not seem to materially affect results; joints would break only one length (30 ft.) from an open end that was free to move. The plan of laying up the joints continuously without any openings was then tried, depending on the strength of the welds to prevent rupture of the line. When these expedients all failed to meet the requirements of a fully satisfactory job the change to riveting was ordered.

When this decision was reached a considerable amount of pipe had been delivered in the field or was ready for delivery that had not, of course, been punched for riveting. Instead of punching and riveting this pipe, it was decided to join it by means of a butt strap placed entirely around the joint and welded at both edges inside and out. This is accordingly being done, making all four welds at each joint by electric arc. These welds, it is to be noted, are lap welds and not butt welds. About 1.3 miles of the line was connected up in the field in this way with very good results.

The pipe is being fabricated and joined both in the shop and the field by the Steel Tank & Pipe Co., Berkeley, Calif., sub-contractors for Twohy Brothers and J. F. Shea Co.

Quebec Rules on Excess Load on Steel Tires

The Roads Department of the Province of Quebec finding that excessive weight is the chief road destroyer, recently decreed that, henceforth, no motor vehicle equipped partly or entirely with non-pneumatic tires shall be driven on public highways when its total weight, including vehicle and load, exceeds 10,000 lb. The weight of a motor vehicle equipped with pneumatic tires must not exceed 12,000 lb., including vehicle load.

Eliminating Force Account for Extras in Road Work

Supplementary Agreements Instead of Force Account Simplify Both Field and Office Work on Georgia Highways

By Fred M. Garnett
Division Office Engineer, State Highway Department, Savannah, Ga.

IT SEEMS quite impossible to estimate the exact cost of constructing a grade or bridge or pavement work, in building highways. No matter how carefully the surveys are made and the quantities estimated, some contingency usually arises under construction that calls for additional work which was not originally anticipated. It has largely been the practice in the past for the State Highway Department of Georgia to pay for such work on a force account basis but this has not been altogether satisfactory and the tendency now seems to be to discourage the practice.

When extra work is done on a force account basis, the state highway department allows the contractor a profit of 10 per cent on all materials and transportation charges, and a profit of 15 per cent on all labor and teams used. This often brings about complications as the item of truck hire does not admit of the usual fifteen per cent profit, but is often included on the contractor's force account. Also the receipted bills for material costs and transportation charges are not always forthcoming which means a delay in rendering statement for settlement to the general office. It seems a difficult matter for the resident engineer or inspector to keep an accurate check on force account work owing to the pressure of other duties in the field; and the contractor's statement of costs usually governs, in case of disputes, owing to the absence of a minute check by the resident engineer or inspector.

Before a force account can be approved for payment, it has to be carefully checked in the division office. All items have to be carefully scrutinized for possible inconsistencies in costs. The cost of labor supervision has to be thoroughly weighed and balanced against labor charges to detect any anomalies. It frequently happens that the division office wishes to consult the resident engineer about a force account, and the resident engineer cannot be reached immediately. The particular item in question has to be omitted from the force account until it can be straightened out, which means that the charge is carried over into another month.

A force account as submitted to the division office is seldom in proper shape to be attached to the monthly statement to contractor. There are usually errors in the computations and the force account has to be made over. The government requires that all materials purchased on force account work be accompanied by receipted bills for such purchases, but such bills are not always attached and it means delays and correspondence to obtain them. Sometimes a force account is approved for payment by the division office and the general office, but when it reaches the government certain charges are questioned. The monthly statement has to be revised in line with the criticism of the government before final payment can be made. When a final statement is submitted to the government, it becomes necessary again to prepare duplicate copies of all force accounts to which are attached statements for

all materials purchased, and transportation charges. In this connection there is a duplication of work that requires a lot of time, inasmuch, as the force accounts have to be revised. There may be some items on the contractor's force accounts that have been paid for but which the government will not allow on its statement. The government does not participate in the cost of such work as moving houses, fences, telephone poles, maintenance and operations costs. In order for the state highway department and the government to approve a force account it has to possess positive qualities. It has to be properly gotten up and thoroughly checked. The fact that the government does not participate in all the costs entails a lot of extra work in the preparation of the final statements. It is somewhat difficult always to anticipate the items to be deleted. Where there are several persons to pass upon certain costs it results in diverse opinions. The main difficulty seems to be in knowing where federal aid leaves off and state aid follows. The line of demarcation is sometimes so finely drawn that it is hard to distinguish just what the government will, or will not, allow on a force account.

Advantages of a Supplementary Agreement—In order to do away with so much detail work and eliminate the element of uncertainty connected with a force account, the State Highway Department of Georgia has been favorable to the use of supplementary agreements. The government through its federal engineers has also indorsed the merits of such agreements. Below is shown a typical form of supplementary agreement:

Project F.A. 177-E Athena, Ga.
Bryan & Chatham Counties February 26, 1926

Mr. H. J. Friedman, Division Engineer,
State Highway Department of Georgia,
Savannah, Georgia
Dear Sir:

I hereby propose to apply ten (10) coats of paint with Water Gas Tar to all piling and piers on the above project, otherwise known as the Ogeechee River Bridge, from the elevation of the bottom pier, which is 1.25 to the elevation of high water mark, which is 9.71, for the lump sum price of Three Hundred Dollars ($300.00). Said work to be done in strict and entire conformity with the State Highway Department Specifications.

Very truly yours,
By G. S. Wright, Contractor

Approved
W. R. Neel,
State Highway Engineer
Approved
Searcy B. Slack
Bridge Engineer

Recommended for Acceptance
H. J. Friedman, Division Engineer

The simplicity of such an agreement unquestionably speaks for itself, but as added collateral proof it possesses the following advantages over a force account.

1. It eliminates a field check on the contractor's forces; thereby releasing the resident engineer for more important work.

2. A definite cost is established in writing and there is no further quibbling among the resident engineer and contractor over certain charges.

3. It eliminates a lot of office work in the division and general offices, by dispensing with a detailed statement of all labor and material costs.

4. It does away with the necessity of having to revise force accounts on the final statement to the government. It eliminates all the supporting sheets that must accompany a force account.

5. It is in such definite and concise shape that the government will approve it for payment.

6. It avoids explanations, disputes, and eliminates correspondence and delays in making payments for extra work.

Preparing Supplementary Agreements—These supplementary agreements are gotten up as follows: When extra work is to be done, the resident engineer makes a survey and estimate of the work to be done. The contractor is asked to submit a proposal in writing setting forth the cost he proposes to do this work for. If the agreement is satisfactory to the division engineer, he makes recommendation that it be accepted, and the agreement is sent to the general office for further execution. If this additional work is satisfactory to the general office at the stipulated price, it is approved and copies are returned to the general office to be placed on file. The work is then carried on the contractor's monthly statement as if the item had been originally bid upon in his contract. Owing to the peculiar nature of some work it is not always possible to have the work done under a supplementary agreement, but where such work can be done, it has been found to be a very satisfactory method to pursue. It has worked out so well in the past that it is fast superseding the old force account method of paying for additional work done under construction.

Arriving at Equitable Cost—The principal thing to be considered in a supplementary agreement is the matter of arriving at an equitable cost. The contractor is entitled to a reasonable profit on the work, and the price to be agreed upon should be just and above criticism. When a contractor submits his proposal for doing extra work, the resident engineer makes an estimate of the probable cost of doing the work, in order that a check be made against the contractor. This prevents the contractor from receiving an unfair price on the work. On the other hand it prevents a modification of the agreement in case the work cost the contractor more than he estimated. An additional check is made in the division office before the division engineer recommends that the agreement be approved. These agreements are further scrutinized and checked in the general office, and by working along these lines extra work is taken care of in a just and satisfactory manner to the contractor and to the state highway department.

French Railway Improves Its Track

In the improvement of track on main line routes a new type of rail joint is being used by the Paris, Lyons & Mediterranean Ry., of France. The two joint ties are placed only 2 in. apart, so as to afford support to the rail ends, but no bridge plate is used to distribute the load over the two ties, nor are the rails laid on metal tie-plates. Four-bolt 19-in. angle bars form the splices, the wide flanges of the bars having large notches to clear the mushroom heads of the three screw spikes in each tie, one spike on the inside and two on the outside. This joint arrangement is said to cause a noticeable reduction in the deflection of track under heavy trains. Other improvements include additional intermediate ties and new stone or clean gravel ballast. In rough country where curves are numerous, special attention is being given to the proper lining of curves and the introduction of transition curves, in order to give a more easy riding track for passenger trains.

Zoning Upheld by United States Supreme Court

Euclid, Ohio, Case Brings First Ruling of Highest Court on Exclusion of Business and Industry from Residential Areas—Height and Other Limitations Taken as Already Accepted

MUNICIPAL zoning ordinances are upheld in a decision of the United States Supreme Court rendered by Justice Sutherland on Nov. 22. Three judges (McReynolds, Butler and Van Devanter) dissented but filed no opinion. (*Village of Euclid, Ohio v. Ambler Realty Co.* on Appeal from Federal District Court for Northern Ohio, which had held the ordinance to be unconstitutional, as reported in 297 Fed. 307.) The opinion is directed particularly to the exclusion of business and industry from areas zoned as residential, never before ruled on by the United States Supreme Court, but in passing it upholds zoning in general as a proper exercise of the police power, stating that height limitations and certain use restrictions other than the one specifically ruled on in the Euclid case are already accepted as constitutional.

Euclid Case—The ordinance in question was adopted Nov. 13, 1922, by the village of Euclid, Ohio, a suburb of Cleveland, with a population of 2,363 in 1920. It divides the village into six use, three height, and four area districts. The Ambler Realty Co. is the owner of 68 acres of land abutting on Euclid Ave. to the south and the Nickel Plate R.R. to the north. To both the east and the west of this tract are "restricted residential plats upon which residences have been erected." Under the zoning ordinance the Ambler tract was distributed between three use districts: U-2, residential, for one-family or two-family houses only; U-3, residential also, but permitting apartment houses; U-6, industrial, within which most of the land in question lies.

The Ambler Realty Co., quoting now from the opinion, in its "bill" alleges "that the tract of land in question is vacant; that for years it has been held for sale and development, for which it is especially adapted, being immediately in the path of progressive industrial developments; that for such uses it has a market value of about $10,000 per acre, but if the use be limited to residential purposes, the market value is not in excess of $2,500 per acre." The company also held that the Euclid Ave. frontage would have its value cut from $150 to $50 per front foot if limited to residential uses.

The suit was brought to set the entire ordinance aside as preventing the use of the land "for lawful and legitimate purposes," again to use the language of the decision, and because the ordinance "constitutes a cloud upon the land, reduces and destroys its value, and has the effect of diverting the normal industrial, commercial, and residential development thereof to other and less favorable locations." The company based its application for an injunction on the allegation that the ordinance violates Sec. 1 of the 14th Amendment of the federal constitution by depriving the company of liberty and property without due process of law, besides denying it the equal protection of the law. The company also claimed that the ordinance offends portions of the constitution of the state of Ohio.

In the lower court a motion was made on behalf of the village to dismiss the bill because the real estate company had made no attempt for relief from the Board of Zoning Appeals. The Supreme Court declares that "the motion was properly overruled."

The Supreme Court agrees with the lower court that, in the light of the record, the real estate company's land along Euclid Ave. would normally be used "for general trade and commercial purposes" while the remainder of the land would normally be used "for industrial and trade purposes." Nevertheless, the Supreme Court upholds the ordinance, even though it "in effect, constitutes a present invasion of appellee's property rights." The opinion disposes of allegations as to the ordinance violating the constitution of Ohio by saying that the question is the same under either the Ohio or the federal constitution. After pointing out that zoning laws are of recent origin and have come along with many other things due to urban growth that would not have been tolerated a century or perhaps a half century ago, but would have been rejected by the courts "as arbitrary and oppressive," it then says that such regulations are changed "under the complex conditions of our day, for reasons analogous to those which justify traffic regulations, which, before the advent of automobiles and rapid transit street railways, would have been condemned as fatally arbitrary and unreasonable." Continuing, the Supreme Court says:

> The ordinance now under review and all similar laws and regulations must find their justification in some aspect of the police power, asserted for the public welfare. The line which in this field separates the legitimate from the illegitimate assumption of power is not capable of precise delimination. It varies with circumstances and conditions. A regulatory zoning ordinance, which would be clearly valid as applied to the great cities, might be clearly invalid as applied to rural communities.
>
> In solving doubts, the maxim *sic utere tuo ut alienum non laedas*, which lies at the foundation of so much of the common law of nuisances, ordinarily will furnish a fairly helpful clew. And the law of nuisances, likewise, may be consulted, not for the purpose of controlling, but for the helpful aid of its analogies in the process of ascertaining the scope of the power. . . . A nuisance may be merely a right thing in the wrong place.—like a pig in the parlor instead of the barnyard. If the validity of the legislative classification for zoning purposes be fairly debatable, the legislative judgment must be allowed to control.

After discussing at some length the municipal ordinance governing heights of buildings and excluding certain nuisance-producing and related industries from stipulated districts, all of which the Supreme Court says has been well established and gives citations to support the assertion, the decision goes on:

> We find no difficulty in sustaining restrictions of the kind thus far reviewed. The serious question in the case arises over the provisions of the ordinance excluding from residential districts apartment houses, business houses, retail stores and shops, and other like establishments.
>
> This question involves the validity of what is really the crux of the more recent zoning legislation, namely, the creation and maintenance of residential districts, from which business and trade of every sort, including hotels and apartment houses, are excluded. Upon that question this Court has not thus far spoken.
>
> The decisions of the state courts are numerous and conflicting; but those which broadly sustain the power greatly outnumber those which deny it altogether or narrowly limit it; and it is very apparent that there is a constantly

increasing tendency in the direction of the broader view. We shall not attempt to review these decisions at length, but content ourselves with citing a few as illustrative of all.

The Supreme Court opinion then cites the decisions upholding zoning in the courts of nine states—Massachusetts, Rhode Island, New York, Louisiana, Illinois, Wisconsin, Minnesota, Kansas, and California—and adverse decisions in three states—New Jersey, Maryland, and Texas. It notes "evidence of a decided trend toward the broader view" that in some states earlier decisions adverse to zoning have been reversed, mentioning Michigan. The opinion quotes at length from the Illinois Supreme Court decision (*City of Aurora v. Burns*) and from the Louisiana Supreme Court decision upholding zoning (*State v. City of New Orleans*). State decisions upholding zoning are summarized in the present opinion as follows:

The decisions enumerated in the first group cited above agree that the exclusion of buildings devoted to business, trade, etc., from residential districts, bears a rational relation to the health and safety of the community. Some of the grounds for this conclusion are—promotion of the health and security from injury of children and others by separating dwelling houses from territory devoted to trade and industry; suppression and prevention of disorder; facilitating the extinguishment of fires and the enforcement of street traffic regulations and other general welfare ordinances; aiding the health and safety of the community by excluding from residential areas the confusion and danger of fire, contagion and disorder which in greater or less degree attach to the location of stores, shops and factories.

Another ground is that the construction and repair of streets may be rendered easier and less expensive by confining the greater part of the heavy traffic to the streets where business is carried on.

After stating that "Zoning has received much attention at the hands of commissions and experts" and referring to "comprehensive reports" on the subject the opinion continues:

These reports, which bear every evidence of painstaking consideration, concur in the view that the segregation of residential, business and industrial buildings will make it easier to provide fire apparatus suitable for the character and intensity of the development in each section; that it will increase the safety and security of home life; greatly tend to prevent street accidents, especially to children, by reducing the traffic and resulting confusion in residential sections; decrease noise and other conditions which produce or intensify nervous disorders; preserve a more favorable environment in which to rear children, etc.

With particular reference to apartment houses, it is pointed out that the development of detached house sections is greatly retarded by the coming of apartment houses, which has sometimes resulted in destroying the entire section for private house purposes, that in such sections very often the apartment house is a mere parasite constructed in order to take advantage of the open spaces and attractive surroundings created by the residential character of the district. Also, coming of one apartment house is followed by others, interfering by their height and bulk with the free circulation of air and monopolizing the rays of the sun which otherwise would fall upon the smaller homes, and bringing, as their necessary accomplishments, the disturbing noises incident to increased traffic and business, and the occupation, by means of moving and parked automobiles, of larger portions of the streets, thus detracting from their safety and depriving children of the privilege of quiet and open spaces for play, enjoyed by those in more favored localities—until, finally, the residential character of the neighborhood and its desirability as a place of detached residences are utterly destroyed.

Under these circumstances, apartment houses, which in a different environment would be not only entirely unobjectionable but highly desirable, come very near to being nuisances.

If these reasons, thus summarized, do not demonstrate the wisdom or sound policy in all respects of those restrictions which we have indicated as pertinent to the inquiry, at least, the reasons are sufficiently cogent to preclude us from saying, as it must be said before the ordinance can be declared unconstitutional, that such provisions are clearly arbitrary and unreasonable, having no substantial relation to the public health, safety, morals, or general welfare.

Considerable space is devoted to elucidating the principle that although a decision like the present one may uphold the general legality of an ordinance, yet some of its details might work injury which would demand relief, but such details must be left, the decision points out, to adjudication each on its merits. The decision then concludes as follows:

Under these circumstances, therefore, it is enough for us to determine, as we do, that the ordinance in its general scope and dominant features, so far as its provisions are here involved, is a valid exercise of authority, leaving other provisions to be dealt with as cases arise directly involving them.

And this is in accordance with the traditional policy of this Court. In the realm of constitutional law, especially, this Court has perceived the embarrassment which is likely to result from an attempt to formulate rules or decide questions beyond the necessities of the immediate issue.

It has preferred to follow the method of a gradual approach to the general by a systematically guarded application and extension of constitutional principles to particular cases as they arise, rather than by out of hand attempt to establish general rules to which future cases must be fitted. This process applies with peculiar force to the solution of questions arising under the due process clause of the Constitution as applied to the exercise of the flexible powers of police, with which we are here concerned.

Illinois River Bridge with Lift Span

For the channel span of the new steel bridge over the Illinois River at Florence, Ill., four designers of movable bridges were employed by the Illinois State Division of Highways to prepare bidding plans and estimates. As a result of the competitive bids a Strauss vertical-lift design was adopted, in which the operation of the span will be effected by a rack and pinion at each end and counterweights will be attached to cables leading over sheaves on top of the steel towers. The movable span will be of the through-truss type, 215 ft. c. to c. of end pins, and will be flanked on each side by four fixed spans of the same type and length, the total length between abutments being 1,950 ft. This bridge, for which contracts have been placed, is on the state highway between Pittsfield and Winchester and will replace a ferry which is hardly adequate to deal with the heavy and increasing traffic. For the middle spans, the clear headroom will be 8½ ft. at high water and 28½ ft. at low water, the former reducing to 7 ft. at the abutments. The lift span will give a clear channel width of 206½ ft. and a headroom of 65 ft. above high-water level when raised. Concrete piers 217 ft. c. to c. will be founded at El. 400 to 426, the roadway level at abutments being at El. 456½. A reinforced-concrete floor 24 ft. wide will be used, except that the lift span will have a creosoted wood paving to reduce the weight. The contractors are Stresenreuter Brothers, Chicago, for the substructure, at $174,454; and the Illinois Steel Bridge Co., Jacksonville, Ill., for the superstructure, at $332,182, the former to be completed by Dec. 1, 1927, and the latter by Oct. 1, 1928. Owing to continued high water in the river, construction work has not yet begun. This bridge was designed under the direction of Frank T. Sheets, chief state highway engineer.

Creosoted Timber Trestles for Louisiana Highway

Swampy Country Crossed by Trestles and Dredged Fills—Gravel and Asphalt Paving—All Piles and Timbers Treated

TIMBER highway trestles, 53 in number, having gravel or asphalt paving and with an aggregate length of 9,153 ft., are included in the new 23½-mile federal-aid road project between New Orleans and Hammond, La., built by the Louisiana Highway Commission and completed in 1926. Two of the structures are 3,013 ft. and 1,445 ft. long. The former, crossing Pass Manchac, which connects Lakes Pontchartrain and Maurepas, has a steel swing span of 161 ft. over the navigable channel. The concrete pivot pier for this span is built on deep pile foundations. Fig. 1 shows a stretch of the highway, with trestles and borrow-pit. Fig. 2 shows the piledriver rig and part of the long Pass Manchac trestle with concrete end pier for the swing span.

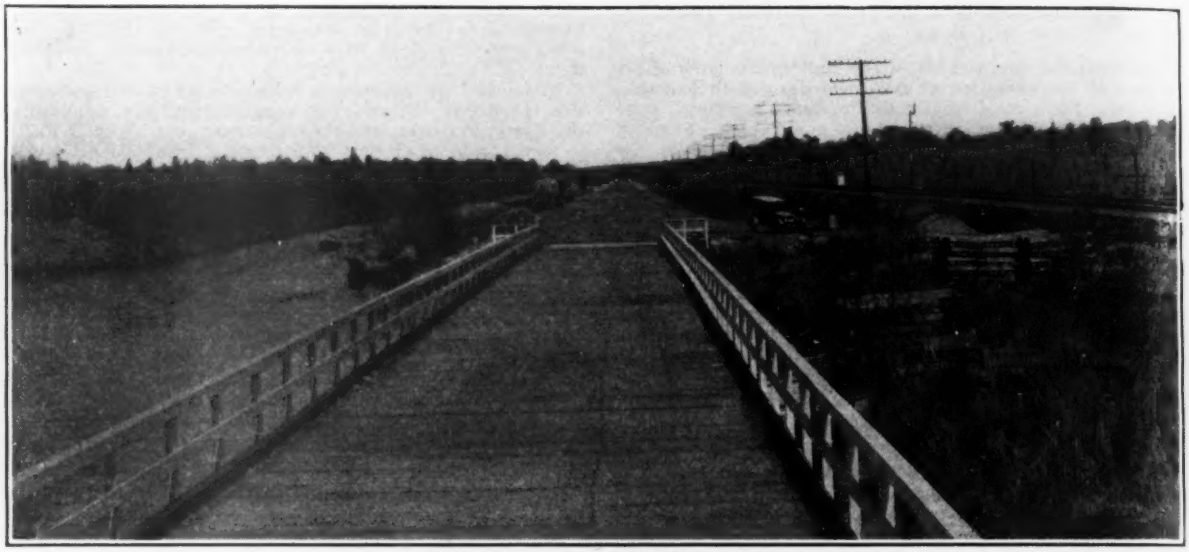


FIG. 1—NEW ORLEANS AND HAMMOND STATE HIGHWAY
End of long trestle ready for gravel paving. Borrow-pit canal at left. Illinois Central R.R. at right. White marks along roadway indicate short trestles.

This 23½-mile stretch of road, between Ponchatoula and Frenier, La., consists mainly of a dredged embankment parallel with and closely adjacent to that of the Illinois Central R.R., and under the Louisiana law all drainage openings and waterways were required to be equal in size with and opposite to the similar openings in the railway embankment. The country traversed is swampy and at an elevation but slightly above mean water level in the Gulf of Mexico, so that at high tide the water flows into these marshes from Lake Pontchartrain.

About 2,320,000 cu.yd. of material was placed by dipper and grab-bucket dredges, working in a canal or borrow pit having a minimum depth of 4 ft., as shown in Fig. 3. The bank has a top width of 32 ft., a height of 6 to 8 ft., and side slopes of approximately 1 vertical on 3 horizontal, these slopes soon being held by a growth of vegetation. The size of the canal, with a minimum depth of 4 ft., varied with the allowance of shrinkage and subsidence of the bank, which allowance ranged from 25 to 200 per cent, according to the density of the clay and muck soil encountered. Plank bulkheads retain the fills at the ends of the trestles.

Trestle Design—All the trestles are of the Highway Commission's standard type, shown in Fig. 4, which is used extensively on roads through the swampy districts. This design provides for a live-load consisting of two typical 10-ton motor trucks plus 30 per cent for impact. For the steel swing span, the live-load is taken as two 15-ton trucks with the same impact allowance. Five-pile bents are spaced 19 ft. c. to c. with all piles vertical and having 10x12-in. caps bolted to them. Upon these caps are twelve lines of joists or stringers. In addition to the drift bolts, each cap is fastened to the two outer piles by pairs of hook-end bars or clamps fitted over horizontal screw bolts through the pile and cap. Between each pile head and cap is placed a sheet of galvanized iron of No. 28 gage, 18 in. square, which is bent down to shed water. The height of deck above water line varies from 5 to 12 ft., and where this height exceeds 8 ft., sway bracing is bolted to each bent.

Piles and Pile Tests—The piles have a penetration of 30 to 60 ft., the specifications requiring a minimum of 12 and 20 ft. in firm and soft ground respectively. The depth of water ranges from shallow to a maximum of 30 ft. A bearing capacity of 10 tons per pile is determined by the *Engineering News* formulas for drop hammers and for steam hammers.

Several piles were tested as to bearing capacity. After being driven to a firm foundation, a timber frame was placed upon the pile head, supporting a platform and braced against tilting by means of guy wires and diagonal struts fitted against the sides of the pile. Upon this platform was placed a sheet-iron tank of 4,000 gal. capacity into which water was pumped slowly until a load of 30,000 lb. or 3,750 gal. was reached. Readings were taken on the pile during loading and for about two days while the pile carried its maximum load.

Gravel and Asphalt Paving—For the deck or floor, transverse planks 4x10 in. and 24 ft. long, are spiked

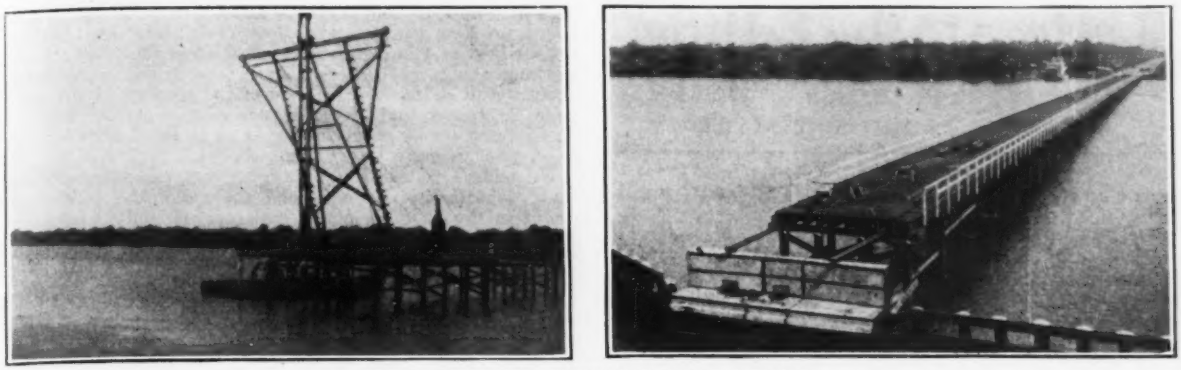


FIG. 2—HIGHWAY TRESTLES IN LOUISIANA

At left; piledriver rig, with ordinary steam hoist. At right; trestle crossing Pass Manchac, with concrete end pier for steel swing span.

to the joists and have a 4x12-in. curb laid along each side to retain a 4-in. bed of gravel. This gravel which is shaped to a 1-in. crown and compacted by traffic, is dressed with a blade scraper several times a week to maintain it in good condition. A 4x6-in. wheel guard is blocked up 2 in. from the floor to give free drainage. This use of a gravel wearing surface to protect the floor

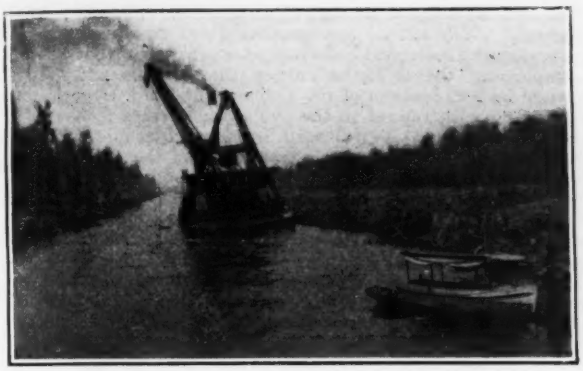


FIG. 3—DREDGE BUILDING FILL FOR ROAD BED

planking is becoming a general practice of the Louisiana Highway Commission.

A different type of floor, however, is used on the long trestle across Pass Manchac, because the height of the deck above the bed of the stream is from 30 to 40 ft. and the extra weight of gravel surfacing was considered objectionable. Here, therefore, the floor is of 2x4-in. timbers laid on edge, spiked together and covered with 2 to 2½ in. of rock asphalt compacted by rolling with an 8-ton roller, and given a crown of 1 in. by additional material in the middle. With this design, also shown in Fig. 4, the wheel guard is laid directly upon a 2x12-in. plank which retains the asphalt paving, drainage being provided by 2-in. notches in the bottom of the guard timber. A clear roadway width of 19 ft. is given on the three longest bridges and 23 ft. on all others. On all these trestles there is a stout wooden hand railing consisting of two rails and a top board spiked to posts which are bolted to both the stringer and cap.

Materials and Construction—All structural timber is Southern yellow pine. The piles and timbers, with the exception of the railings, are creosoted by the empty-cell process, giving 8 lb. of oil per cubic foot for the floor planks and 12 lb. for all other material. The hand railings, of untreated heart pine, are given two coats of white paint. This work required 1,880,000 ft. b.m. of creosoted timber, 85,000 ft. b.m. of untreated timber and 126,800 lin-ft. of creosoted piling. Work on the dredged fill was begun in 1923 and completed in 1925 at a cost of $750,000, including the necessary clearing and grubbing. The bridges, begun in 1924 and completed in 1926, cost about $350,000 inclusive of the steel swing span.

Engineers and Contractors—On this work the contractors were the McWilliams Dredging Co., Memphis, Tenn., for the embankment, and the Austin Bridge Co., Dallas, Tex., for the trestles and swing span. J. W.

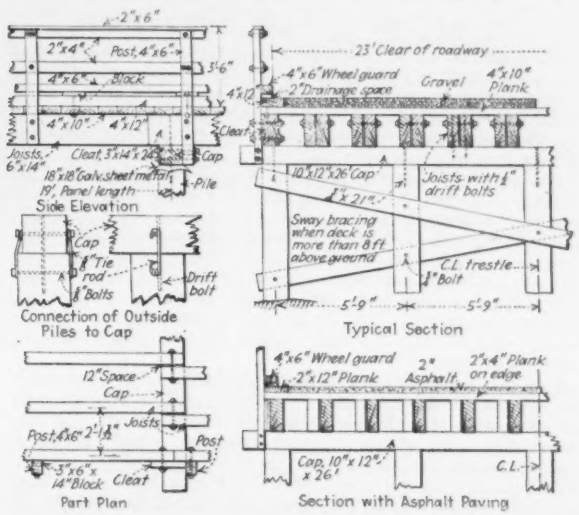


FIG. 4—TRESTLES WITH PAVED FLOORS; LOUISIANA HIGHWAYS

Grace was superintendent of construction for the bridge company. All design and construction work for the bridges was under the direction of N. E. Lant, bridge engineer of the Louisiana Highway Department; W. F. Cooper was engineer of construction on embankment and surfacing; George Robert, resident engineer of bridges, and H. P. Mehler, resident engineer on the road work.

Correction Regarding Japanese River Mattress

In *Engineering News-Record* Aug. 12, 1926, p. 248, in the article on the behavior of flexible concrete mattresses in Japanese rivers, two figures in the table were incorrect and should read: 11,166 in place of 10,866, and 40.94 in place of 20.47.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

How Can Freezing of Fire Hydrants Below Ground-Water Level Be Prevented?

Sir—One of our customers, a water-works superintendent, has about 300 hydrants of several different makes in the ground, and owing to the severe rains in the late summer and during the fall, the ground in his city is full of surface water, which means that the hydrants have water in them up to within about 2 ft. below the ground level.

The question is: What is the best way to get out of his trouble? Of course the most positive way would be to dig up every hydrant and plug up the hydrant drains and use a hydrant pump. Owing to the large number of hydrants there, however, the excessive cost involved would be prohibitive.

Among certain solutions we have thought of is to pump out the surface water and fill the hydrant full of kerosene, but this would destroy the rubber hydrant valves used in some makes of hydrants. Another solution suggested was to pump out the hydrants and fill them full of salt, but the freezing point of salt water is but a few degrees lower than that of plain water. Another solution is to fill the hydrants full of alcohol or use a solution of chemically pure calcium chloride.

FRED A. WATEROUS,
Vice-President, Waterous Fire Engine Works.

St. Paul, Minn.,
Nov. 2, 1926.

Forcing Construction of Sewage-Works

Sir—We have been somewhat surprised and disappointed at not seeing any correspondence in *Engineering News-Record* following your editorial note on Sept. 9 which criticised state health departments rather broadly for attempting to force the construction of sewage disposal systems on reluctant communities.

The refusal "to grant permits for sewer extensions" of which you complain probably does not occur until, as you say, the orders of the state department to build sewage-works have been disregarded by the community in question. Such orders are seldom issued until the state is convinced that a nuisance exists which could be lessened by the construction of purification plants and, as far as we know, until the state is satisfied that the community is able to finance and should, for the benefit of the public health, build such works.

Is it not logical that the state authorities, charged with the duty of protecting public health, should be reluctant to see dangerous conditions needlessly increased during the period that must elapse between the time when the state has started the machinery in operation to secure the needed improvement and the time when conditions become so bad that individuals who suffer from the nuisance despair of the success of the state's efforts and themselves resort to the available remedies at law? And do we not find that the local authorities who are responsible for the construction of sewage-works are often reluctant to assume the responsibility, before the voters who elect them, for such a necessarily heavy expense, even when they feel that sewage treatment would be a great benefit, and that they frequently welcome the pressure which an outside, state authority can bring to bear so much better than any local individual?

Our experience with health departments has been that they are very ready to meet the local authorities more than half way in issuing orders with which they can reasonably comply, and that they allow temporary and mild nuisances to continue for reasonable lengths of time while the local authorities are doing what they can toward remedying them.

You are of course correct in saying that getting pure water is more important than filtering sewage, but all the state boards we know of are at work simultaneously on both problems and are heartily in agreement with you as to their relative importance.

It is true that our contacts have been with the health boards of New England and New York State only, but we are inclined to doubt very seriously if other departments are working along very different lines from those we do know about. And at least in this part of the country we are sure your statement that "a large percentage of the sewage-works built are so poorly operated as to be of little benefit to anyone" is much too strong.

We believe it would be closer to fact and fairer to the state departments to commend them for the increasing attention they are giving to maintenance and to say that even an indifferently operated disposal plant produces conditions so much better than the discharge of crude sewage would cause that its expense is usually fully justified.

We are prone to forget former conditions after disposal works have been put in, and the density of urban population has increased so much in the last twenty years that conditions would today be absolutely intolerable were it not for the sewage-works which have been built in large measure because of the wisely applied pressure of the state health departments.

HENRY R. BUCK,
of Buck & Sheldon, Engineers and Architests.

Hartford, Conn.,
Oct. 21, 1926.

Chemico-Mechanical and Biological Sewage Treatment Processes

Sir—I was much interested in the letter of Louis Tribus on p. 756 of your Nov. 4 issue. This was headed "Hopes Chemico-Mechanical Sewage Treatment Will Replace Biological." Why should one consider these two processes as opposing the biological? Rather, it would seem, they should complement the biological along the lines recently suggested by Mr. Jackson of the Connecticut State Department of Health with regard to the use of chemicals.

The work of the New Jersey Sewage Experiment Station has served to emphasize once more the fact that the ways of nature are wasteful and to point out to the engineer means by which he may conserve and make use of nature's forces in an economical way and to the benefit of mankind. As the writer understands it, to do that is the function of the engineer.

Three things have, heretofore, stood in the way of real progress in the art of sewage disposal: (1) Ignorance of the fundamental principles involved; (2) attempts to commercialize certain "systems" which were only partial treatments at best, to the exclusion of all other processes; (3) various attempts to "try out" this, that and the other without any foundation of knowledge either to direct the investigation or to judge of the results.

The ignorance mentioned has been due to the lack of facilities for properly attacking the problem from all sides at the same time. The establishment of the New Jersey Sewage Experiment Station has for the first time made such attacks possible. In accord with the majority of the Research Committee of the New Jersey Sewage Works Association the writer has insisted that, until a sufficient ground work has been established, the station's efforts should be confined to the revelation of fundamentals; that each problem attacked should be scrutinized from the chemical, biological, bacterial, botanical and physical viewpoints at one and the same time so that no if's or and's can crop up in the future.

Some have been impatient of this slow methodical course and have demanded immediate practical results or have demanded that the station be run on the "tryout" plan. At the present time sufficient progress has been made in the determination of fundamentals so that these principles can be applied by the engineer who recognizes his duty to be as suggested in the third paragraph of this letter. There are those who are sitting back waiting for a formula for a perfected disposal plant to be handed to them, those who poohpooh these scientific investigations as impractical, and there are also three or four well-known engineering firms who are greedily absorbing as much information as possible and setting their own organizations at the task of interpretation and application. Furthermore, there are some commercial firms which have thought it worth while to establish fellowships at a cost of $2,000 per year in order that student workers may give their time under the capable direction

of Dr. Rudolfs, laboratory chief, to the interpretation and application of fundamentals to their own benefit.

May I give a few illustrations of mechanical and chemical treatments which are highly satisfactory partial treatments or as adjuncts to other processes but which are absurd when considered as a panacea?

Screens are excellent adjuncts to settling devices but the screen salesman makes himself ridiculous when he offers a screen able to remove 7 per cent of the settleable solids as a substitute for a settling tank which will remove from 50 to 70 per cent.

Lime may be applied to sludge to cause flocculng and separation and adjust reaction with excellent results, but treating the 3,000 gal. of sludge resulting from the sedimentation of 1 m.g. of sewage and treating 1 m.g. of sewage with lime are two different propositions. The latter but complicates and aggravates the sludge problem which we seek to solve.

It is perfectly practical to treat a few barrels of salt with electric current and use the resulting chlorine to sterilize sewage, but to dilute the salt in the whole flow of sewage and then use enough electricity to "transpose virtually all of the putrifactive contents into inorganic elements" does not appeal to the conservative engineer.

Heat has been proposed as a treatment even to the ultimate limit of complete distillation of the sewage liquid. On the other hand there are those to whom the problem of heating sludge to 70 or 75 deg. F. for the purpose of accelerating digestion has appeared to be an unsurmountable difficulty. The writer has had the privilege of demonstrating that this problem is ridiculously easy of solution.

With the fundamental knowledge now available, anyone with $2,000 worth of faith in an idea can secure a scientific investigation of its merits together with an authoritative explanation of the phenomena involved which will weather the test of time and criticism as no amount of ignorant and arrogant sales patter can do.

By all means let us have machinery and chemicals whenever they will do the job better, even at a reasonably greater cost, but let us apply either or both only in the light of all possible information on the subject. Above all let us add to the store of the latter.

JOHN R. DOWNES,
Supervising Engineer, Plainfield Joint Sewage-Works.

Bound Brook, N. J.,
Nov. 13, 1926.

Traffic Increases More Rapidly than Motor Car Registration

Sir—The study of the possible relation between motor vehicle registration and average income made by Prof. N. W. Dougherty and published in *Engineering News-Record*, Sept. 23, 1926, p. 500, is a very interesting contribution to the very perplexing problem of prediction of probable future traffic on highways. Professor Dougherty says that "It has been found in Tennessee, and data from other states confirm the conclusion, that traffic increases approximately as motor vehicle registration." Recent studies made by the New Jersey State Highway Department indicate, however, that highway traffic is increasing much more rapidly than registration. In this, of course, it is following the course of all traffic developments in this New York metropolitan area and in many other places where there is an increase of the use of facilities due to the fact that these facilities are provided. The comparison for the last three years is:

Year	New Jersey Motor Vehicle Registration	Registration Increase Per Cent	Traffic Increase Per Cent
1923	...	...	...
1924	439,239	20	32
1925	515,919	17	28
1926	592,126	15	25

The traffic counts are the average at eight points, one on each of the eight most important routes. In this connection also the following comparison between the increase in ratables, motor vehicle registration, and receipts from the latter in New Jersey, may be of interest:

Year	Ratables Increase Per Cent	Registrations Increase Per Cent	Motor Vehicle Revenues Increase Per Cent
1910	...	...	...
1915	26	81	230
1920	26	167	230
1925	46	145	200

There is also another important point to be noted in connection with the design of locations and constructions, namely, the different rate of increase on different routes. On the eight main routes in New Jersey the increases for the past three years have been:

Route No.	Increase in 3 Years Per Cent
1	118
2	78
3	124
4	52
5	67
6	138
7	56
8	77

The prediction of future highway traffic is an art which requires not only the accumulation and proper estimation of all factors of past experience bearing on the subject, but the exercise of good judgment and courage in looking ahead.

F. LAVIS,
Engineer, New Jersey State Highways Commission.

Jersey City, N. J.,
Oct. 22, 1926.

Urges That New York City Go to Housatonic River for Water

Sir—The editorial on the proposed scheme for an additional water supply for New York City in your issue of Oct. 28 is very interseting.

It seems to me that a journal of your standing could render a tremendous service by making it clear to the public that there is no physical reason why twice the supply from the proposed East River collecting system could not be obtained from the Housatonic River at half the cost. The proposed Hudson River East Side system is estimated at, say, $300,000,000 to produce 400 m.g.d. From the Housatonic a reliable authority states that 800 m.g.d. can be obtained for about $150,000,000.

What stands in the way of this tremendous saving is a bunch of lawyers and politicians. If the physical facts stand as I have stated, which can easily be proved, it would take two intelligent business men—one from Connecticut and one from New York—not over 24 hours to get together on this project.

Make it plain to the public how much it is going to be loaded with additional taxes, bond interest, etc., in paying four times as much per gallon of water on the East Side of the Hudson project as they would on the Housatonic River project. You have not begun to put the weight on this waste of money that you ought to.

GEORGE R. WADLEIGH,
Manager, West Virginia Pulp & Paper Co.

New York City,
Nov. 15, 1926.

[The plan looks simple, but how get rid of the "bunch of lawyers and politicians"; or in fact, how execute it without them?

Fifteen years ago *Engineering News* devoted much space to an advocacy of a temporary supply from the Ten Mile River, a main tributary of the Housatonic, to meet a threatened water famine. Attention was then called to the fact that John R. Freeman in his report to the Merchants' Association of New York, made in 1900, had recommended the Housatonic but that the association, on the advice of lawyers, held it to be legally impracticable; and it was urged editorially that a way could be found to obtain consent from the Connecticut legislature. The Board of Estimate approved plans made under the direction of the late I. M. de Varona, then chief engineer of the Department of Water Supply, for an emergency supply from the Ten Mile River, to be used only during high river stages, to lessen damage claims, and the work was about to be put under way in the autumn of 1915, when water from the Catskill supply was available before the next serious danger of water shortage came. (See *Engineering News*, May 18, 1911, p. 604, for lengthy editorial, with maps and diagrams, on the suggested plan of relief; June 1, 1911, p. 665, "The Law Regarding Control of Waters Crossing State Boundaries," accompanying a lengthy reprint of a legal review with the same title, made to the Merchants' Association in 1904 by Carman H. Randolph; a short illustrated staff article, June 8, 1911, p. 705, based on a visit to the site of the proposed dam on the

Ten Mile River; and a concluding editorial, Oct. 26, 1911, p. 510.)

Mr. Randolph's legal review suggested that in the case of interstate waters the right to diversion from one state to another might undoubtedly be secured by interstate compacts or treaties, approved by Congress, and might perhaps be obtained through federal court action for equitable relief." It is just such a compact, as to the Delaware River, between New York, New Jersey and Pennsylvania, that has been hanging fire for some three years, with no certainty as to its outcome. How long relief through court action would take is a matter for conjecture. Five to ten years would not be surprising, and then the decision might be negative.

Meanwhile, New York water demands increase rapidly. Water must be had, regardless of cost.

Why New York City has never undertaken to get New York State to negotiate with Connecticut for a Housatonic River compact we can only guess. One possibility is the strong presumption of opposition from the Housatonic valley and the state of Connecticut generally; and another is that until the New York legislature removes its bar against the taking of water for New York City from Dutchess and Columbia counties, north of the Croton collecting area, it could not with good grace go to the Connecticut legislature for a Housatonic River compact.

Unquestionably interstate water utilization compacts must come. They must include many possible uses: Water and water power in the East and both these and irrigation in the West, with land drainage or flood protection, mining and navigation, added in some regions, and with reasonable use of water for sewage dilution and disposal everywhere.

No two or more business men can cope with the matter. They would be as helpless as babes without not only lawyers but engineers also, first and foremost. Politicians also are necessary. All must be backed by an enlightened public opinion.—EDITOR.]

Mosquito Expugnatus Est, Homo Victor

Sir—My attention has been called to the editorial note, "*Mosquito Triumphans*," in *Engineering News-Record*, Sept. 30, p. 527, and I write because the mistaken impression which some may receive from it needs to be corrected.

One begs the question when he states that "they cannot clean up Cape Cod or New Jersey." It is true that Col. William C. Gorgas did succeed in controlling mosquitoes in Panama where conditions were so serious that they may be said to represent the very extreme of difficulty. But he had to fight for his authority, his appropriations, and the privilege of carrying out his own ideas. Even the canal commissioners were not wholly in sympathy with his plans. Call it theory, if you will. Nevertheless his plans were finally carried out, and today it is generally recognized that had not this anti-mosquito work been done the canal would never have been completed.

Probably no such great amount of money has ever been spent per unit area on Cape Cod or in New Jersey as was used in Panama. What has been done can again be done. Even an engineer must admit it, and when funds are available to clean up Cape Cod, New Jersey, or any other mosquito-burdened area, and the expenditures are directed by intelligent efforts, the areas will be cleaned up. Here in the North mosquitoes are not so deadly. Yellow fever is rare, though there are a number of cases on record where epidemics have broken out in Northern cities, presumably explained by yellow fever mosquitoes being transported by ships from the West Indies. Malaria, though frequent, is not so malignant as in the Tropics. In other words, here it is more a matter of comfort than of life or death, or even of good health. Our people as a whole are apathetic. They say that we have always had mosquitoes and always will have them. So long as the majority of the taxpayers feel like this, there is small chance of their voting adequate appropriations to free a town or a state from mosquitoes.

The chief mosquito nuisance of the North Atlantic States comes from the salt marshes. Shallow pools which dry out completely between perigee tides become filled with water the next time the marsh is flooded. From eggs already laid in the mud, tiny wrigglers hatch. and if the water does not evaporate or seep away too soon, millions of mosquitoes will be produced. A week at summer temperatures is sufficient time for a brood to develop. Salt-marsh mosquitoes migrate in search of food, which consists of the blood of man and the higher animals. Without it the females are unable to develop eggs. Consequently they fly inland until they are able to procure the necessary food. Thus, because they migrate sometimes as far as forty miles, and are produced in such enormous numbers, they form the vast plague of the coast area. "Jersey mosquitoes" are mentioned in many a quip and newspaper joke, but mosquitoes are not confined to New Jersey, and they are just as large and just as abundant in any of the other North Atlantic States where similar areas of salt marsh provide breeding grounds for them.

Ditching of the salt marshes (not draining, as the engineer understands the term) prevents the water from standing in shallow pools long enough to develop mosquitoes. Deep pools contain fish which devour the wrigglers. Where adequate ditching is installed, the water is all in the ditches and connected with tide water, and mosquitoes cannot breed there for two reasons: (1) the motion of the water prevents it, and (2) fish devour the wrigglers. This is not a theory but has been demonstrated many times by practical proof. Much work of this sort has been done in Northern New Jersey, on Long Island, and in Connecticut, Rhode Island, and Massachusetts. Wherever it is properly done there has been a marked relief in freedom from the mosquito nuisance. But as a rule only small areas have been ditched at a time, and in order to obtain the best results large areas should be treated. Then the work must be maintained or it will depreciate rapidly.

Much of the criticism of anti-mosquito work is due to a lack of maintenance. When first completed, it shows a wonderful improvement. But high tides, winter storms, and human agencies are responsible for the clogging of ditches, and if the obstructions are not promptly removed, breeding places are formed. After a few years it will be necessary to recut certain ditches where the formation is such that the banks do not hold. In other words, frequent examinations and corrective measures, where needed, are absolutely essential. In this respect mosquito ditching may be compared to a new trunk line highway between large cities. If the roadbed is not examined and repaired when needed, the heavy traffic and the elements will soon cause marked depreciation, and in a few years it all goes to pieces and may be no better than the old road which it replaced at tremendous expense. Mosquito ditches must be maintained.

Elimination of mosquito breeding in fresh-water swamps is simply an engineering problem. No one will say that it cannot be solved. After all salt marsh and fresh-water areas have been given attention and the principal mosquito nuisance abated, there will still be a rain barrel mosquito problem. This is usually due to the negligence of property owners or residents. Receptacles such as rain-barrels, buckets, tin cans, clogged gutters, or depressions in the ground which catch and hold rain water, will surely breed *culex pipiens*, the rain barrel or house mosquito. In order to remedy such a situation, a house-to-house inspection is essential. Occasionally there is a fresh-water stream which becomes so polluted by waste from slaughter houses or factories that the fish are killed or driven away. In periods of scanty rainfall the house mosquito may breed in such places in large numbers. But this mosquito is local in its prevalence and does not migrate long distances as do the salt marsh species. Until we can change human nature or educate all of our people to do better, it will probably be necessary to continue the inspection of premises at public expense. When a public sentiment has become sufficiently aroused, there will be funds for the purpose. Then, and not until then, will the mosquito problem be solved. As mosquitoes breed only in stagnant water, it follows that if stagnant water is done away with, mosquitoes will likewise be abolished. Let us not say, "It cannot be done!" Let us rather believe that it can be done. Instead of "*mosquito triumphans*," let us take the motto, "*Mosquito expugnatus est, homo victor!*"

W. E. BRITTON,
State and Station Geologist, Connecticut Agricultural Experiment Station.
New Haven, Conn.,
Nov. 2, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

San Francisco Supervisors Change Bay Bridge Policy

Resolve to Select Own Site—Draw Plans to Submit to War Department

After several months of detailed attention to the question of building a bridge from San Francisco to Oakland, the San Francisco board of supervisors on Nov. 22 (1) decided to ask the War Department indefinitely to postpone the hearing in Washington set for Dec. 10 and (2) referred a resolution proposing a new policy on the bay bridge situation to the special bridge committee consisting of members of the city's finances, public utilities, and commercial development committees. Previous reference to the bay bridge situation and a tabulation of the applications for franchise now before the supervisors appeared in *Engineering News-Record*, Oct. 28, p. 720.

The new turn of affairs is ascribed partly to recent adverse comment on the proposed sending of a delegation to Washington and partly to the advice of Gustav Lindenthal who recently appeared before the board. Mr. Lindenthal, in answer to a question as to the best procedure, advised the city to select its own site for the bridge, prepare complete plans and then get the approval of the War Department, after which the financing could be definitely considered.

The resolution outlining the new policy considerably extends the functions of the engineers that the board early in October decided to appoint, but who have not yet been named. The plan is to finance the bridge by a bond issue, paying off the bonds as they mature with the profits from the tolls collected from bridge traffic.

TEXT OF RESOLUTION

The resolution follows: Resolved (1)—That the work of the three consulting engineers to be retained by this board shall not be confined to reporting on the private projects already submitted, but shall be extended to include the selection of an ideal site or sites, and the study and testing of such site or sites in every necessary way, looking to the adoption by this board of a location which shall be the selection of the city of San Francisco itself; and

(2)—That, after selecting such site, this board shall next proceed to have complete plans and specifications drawn up, likewise under the eminent engineers employed by this board, which plans and specifications shall be adopted as the official plans and specifications of the city of San Francisco; and

(3)—That the said engineers, accompanied by the proper city officials and committee of this board, shall then proceed to obtain the sanction of the War Department for the construction of the bridge itself; and

(4)—That the question of financing the bridge, whether by private parties under competitive bidding, or by the use of public funds, shall be left for decision until such time as the city's plans are approved and the project ready to construct.

Commenting on the new proposal Supervisor W. H. Harrelson, an engineer, said: "I shall want to know who are to be on the consulting board before I can agree to the plan suggested. If we get real engineers, all right; if they are political engineers, then it is all wrong."

Engineering Fifty Years Ago

From *Engineering News* of December 2, 1876

THE Holly system of water supply has lately been introduced into Garden City, L. I., and apparently to the great satisfaction of the citizens of that place. A trial of the engines and the efficiency of the system was held on the ninth of last month, when quite a number of persons interested in Garden City real estate were present. Everything worked satisfactorily, and now the Garden City people are enjoying the benefits of cheap insurance, and of unlimited supply of water brought directly to any part of their houses.

Allegheny County Opens Ninth St. Bridge

On Nov. 26 the second of the three downtown Allegheny River bridges, the Ninth St. bridge, was opened to traffic by officials of Allegheny County, Pa. It is a self-anchored chain suspension bridge of 430-ft. main span and 215-ft. side spans, a duplicate (except for a few feet difference in length of span) of the Seventh St. bridge, opened a year ago.

The third of the group, the Sixth St. bridge, will be closed to traffic by Jan. 1, and its truss spans will be floated by barge to the Ohio River Back Channel crossing at Coraopolis (to Neville Island), where they will form the main part of a bridge to replace the inadequate existing bridge. Construction of the Sixth St. bridge will progress actively throughout the 1927 season.

Another Paper Mill for Quebec

A large paper mill is to be erected at Grande Baie, Que., by Price Bros. & Co., Ltd. Erection work will commence in the spring. The company recently purchased a large area of land in the vicinity of Grande Baie and it is understood other properties will be bought over before the end of the year.

Supreme Court Maintains Reproduction Cost

In Indianapolis Water Case Reversed Commission Confirms 7 Per Cent Return

In a decision handed down by the United States Supreme Court last week, the fixing of the rates of the Indianapolis Water Co. by the Public Service Commission of Indiana was held to be confiscatory in that the total valuation which the commission assumed was too low, because it was not computed on present-day costs. The case was brought before the Supreme Court by the appeal of the commission from a lower court injunction against the rates established.

The major issue decided by the court was the establishment of the propriety of present-day reproduction of the cost of the entire property, less depreciation, as a basis for rate fixing. The commission advanced the theory that the rate base should be the cost of reproduction based on average prices in the 10 years ending with the year of the rate fixing. Comparative figures by the engineering experts on both sides were given in the lower court case. The commission's engineer found the value of the property based on spot prices of Jan. 1, 1924, to be $19,500,000, and on the average prices of the 10 years ending with 1923, $17,000,000. The company's experts found the spot price 1924 value to be about $22,000,000 and the average price for the ten years ending with 1923 around $19,000,000. The rate base which the commission adopted, however, which was as of May 31, 1923, was $15,260,400, which was based on the reproduction cost figured from the average prices in the 10 years prior to that date, and the rates authorized then were expected to bring in $800,000, the commission stating that while those rates might not produce a 7 per cent return for the immediate future, on the average over a period of approximately three years the schedule would produce an adequate return. In other words, the commission admitted the justification of a 7 per cent return.

In its petition, the company claimed "that the fair value of the property on Jan. 1, 1924, was not less than $19,000,000," and on that basis made its appeal for an injunction.

The Supreme Court upheld the company on the basis of the old Smyth-Ames rule of the court "that the present value of property must be a major matter of consideration in establishing rates." The court said, "In determining present value, consideration must be given to prices and wages prevailing at the time of the investigation, and in the light of all the circumstances there must be an honest and intelligent forecast as to probable price and wage levels during a reasonable period in the immediate future. In every confiscation case, the future as well as the present must be regarded." On the as-

(*Continued on p. 926*)

Railway and Port Facilities to Be Built in Panama

In order to develop more of the rich coffee country in Chiriqui Province, the Government of Panama has let a contract to F. H. Arosemena, a citizen of Panama, to build an extension of the Chiriqui National R.R. from Concepcion to Puerto Armuelles, a distance of 51 km. (32 miles), and to build a 1,300-ft. reinforced-concrete pier at the new deep water harbor of Puerto Armuelles.

The railroad will be of 36-in. gage and will have a total of 58 steel bridges. Approximately $3,000,000 will be expended upon the construction and equipment of the railroad.

Mr. Arosemena has let a contract to the J. G. White Engineering Corporation of New York for the construction of the railroad and the design and construction of the wharf.

Tri-State Compromise Treaty on Delaware River Water Sought

Engineers representing New York, New Jersey and Pennsylvania are working on a compromise plan for a treaty for the division and utilization of the waters of the Delaware River common to the three states, according to a statement by Willard I. Hamilton, vice-chairman of the Tri-State Delaware River Commission and chairman of the New Jersey Water Policy Commission. The tri-state report made in 1925 was approved by the New York Legislature only. The New Jersey Legislature referred the matter to a new state commission (named above) which reported adversely; after which its members were authorized to act for New Jersey on the tri-state ommission.

Will Build 230 Miles of Railway in Texas

Long Controversy Over Projected Lines in Texas Panhandle Brought to a Close

The long controversy over the proposals of four railroads to build new lines in the South and East plains region of the so-called Texas Panhandle has been brought to a close by the action of the Interstate Commerce Commission in authorizing the construction of a total of 230 miles of railway by two companies and denying the applications of two others.

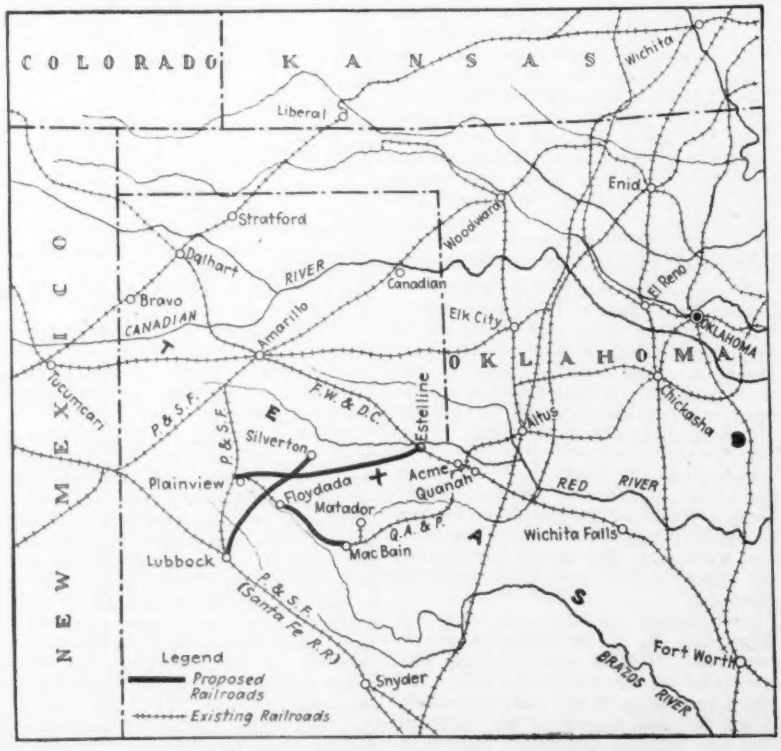
The four railroads concerned are the Texas, Panhandle & Gulf R.R. Co., a new and independent company, the Pecos & Northern Texas Ry. Co., a subsidiary of the Santa Fe, the Fort Worth & Denver South Plains Ry. Co., a subsidiary of the Colorado & Southern Ry. which is controlled by the C. B. & Q., and the Quanah, Acme & Pacific Ry., a subsidiary of the Frisco. The new lines proposed by the first three companies call for considerable duplication in the region around Plainview, Tex., while the proposed line of the Quanah is to give a connection with the Santa Fe in order to provide a new route to the same territory. The commission in reaching its decision considered that whereas the application of the T. P. & G. had some desirable features and served some territory not reached by the other lines, it was a new company with a doubtful ability to raise the necessary funds for construction. The advantages of the proposed line of the Fort Worth & Denver South Plains over that of the T. P. & G. or of the subsidiary of the Santa Fe was that the Denver was in a better position to finance and carry out construction than the T. P. & G. and that it would provide competition in territory now served by the Santa Fe alone.

The construction authorized for the Fort Worth & Denver South Plains Ry. is from a connection with the Fort Worth & Denver City Ry. at Estelline in a general westerly direction to Plainview and thence northwesterly to Dimmitt, near the center of Castro County, a distance of 132 miles, also from the city of Lubbock northerly to a connection with the new line to Plainview and thence on to Silverton, a distance of 70 miles. The proposed line will have a maximum grade of 1 per cent and a maximum curvature of 6 deg. The estimated cost is $6,270,000.

The proposed line of the Quanah, Acme & Pacific Ry. is to extend from McBain in a westerly direction to Floydada, where it will connect with the lines of the Santa Fe. This line will be 28 miles long, with similar grades and curvatures to the other line and will cost $1,032,000.

The Interstate Commerce Commission in its order stipulated that the construction of both lines must be begun before Jan. 1, 1927, and that the line of the Quanah must be completed by the end of 1927, and that of the Denver by the end of 1928.

The applications of the Texas, Panhandle & Gulf R.R. Co. and of the Pecos & Northern Texas Ry. Co. were denied without prejudice to their being resubmitted at some future date when traffic conditions seem to indicate that the additional lines will be desirable.



NEW RAILWAYS TO BE BUILT IN TEXAS

Sewage Treatment Conference Held in Iowa

For the eighth time a conference of sewage treatment has been held under the auspices of the Engineering Extension Department, Iowa State College. The latest of these meetings was held at Ames, Nov. 16 to 18. Most of the speakers were connected with the college named, or with the Iowa State University, or the Iowa State Department of Health, or else were Iowa engineers or operators. Speakers from outside Iowa included Isador W. Mendelsohn, sanitary engineer, U. S. Public Health Service, Chicago; Ernest Boyce, chief sanitary engineer, Kansas Board of Health; N. T. Veatch, consulting engineer, Kansas City, Mo.; Wayne A. Kivell, sanitary engineer, The Dorr Co., Chicago; H. F. Ferguson, chief sanitary engineer, Illinois State Board of Health.

Passaic County Park Commission Being Formed

Action for establishing a park commission for Passaic County, N. J., has been started under the state enabling act of 1890. A temporary commission, with Robert D. Benson, Passaic, as chairman, has engaged Olmsted Brothers, Brookline, Mass., to make a survey and report preliminary to a county vote next November on establishing a permanent commission with power to issue some $2,500,000 of park bonds.

Los Angeles Aqueduct Damaged by Flood

On Nov. 27, following a rainfall of 6¼ in. in 60 hr., slides choked the open canal section of the Los Angeles Aqueduct above Haiwee Reservoir, about 192 miles north of Los Angeles. The overflow undermined the concrete lined canal for 300 ft. and cut a ditch 30 ft. wide through the embankment.

Reconstruction, involving 25,000 cu.yd. of fill and the rebuilding of concrete sidewalls and the supporting embankment, is estimated to require ten days. Work is being done by 150 men under the personal direction of Chief Engineer William Mulholland, who supplied the foregoing facts, and Assistant Chief Engineer Van Norman. The Los Angeles water supply is in no wise endangered due to the fact reservoirs are full.

Full Section Moffat Tunnel 73 per Cent Complete

Holing through of the headings of the pioneer or water tunnel being driven in connection with the 5-mile Moffat Tunnel, 50 miles from Denver, is expected to occur in March. On Nov. 1 the distance between headings was 2,022 ft. for the water tunnel and 3,499 ft. for the railway tunnel, while the distance between the full-size sections of the latter was 8,525 ft. The progress record up to Nov. 1 was as follows, and it will be recalled that the earlier rapid advance was checked seriously by an inrush of water in the east heading and a slide in the west heading, as noted in *Engineering News-Record* of June 17, Aug. 5 and Aug. 26, pages 985, 231 and 356.

	From East Portal Ft.	From West Portal Ft.	Total Ft.	Per Cent Finished
Water tunnel...	17,166	13,195	30,361	94
Main headings...	16,574	12,180	28,754	89
Full section.....	14,143	9,585	23,728	73

Building Trades Employers to Meet in Pittsburgh

Will the demand of organized labor in the building industry for the five-day week as enunciated at the recent convention of the Building Trades Department of the American Federation of Labor, held in Detroit, if permitted to be placed into operation, seriously affect the construction industry? Should the contractors of the country unitedly oppose such a demand on the part of labor? Will there be wage increases generally next year? What is the outlook for the industry for the coming year?

These questions are among those to be discussed by contractors of the country at a national conference which will be held Dec. 13, 1926, beginning at 10 a.m. at the William Penn Hotel, Pittsburgh, Pa. under the auspices of the National Association of Building Trades Employers.

Four-Track Railroad Bridge Over Newark Bay in Use

The $10,000,000 four-track bridge of the Central Railroad of New Jersey over Newark Bay, between Bayonne and Elizabeth, N. J., was put into service on Nov. 28. The bridge proper consists of an east approach viaduct, two sets of twin double-track vertical-lift spans, respectively 305 ft. and 216½ ft. long center to center of piers, and 41 deck plate girder spans 124½ ft. long, all of four-track construction, giving a total length of 7,411 ft. With the approach fill, grade-crossing elimination and necessary changes in track alignment, the total cost of the operations will be about $15,000,000. The bridge is designed to replace the present low-level trestle crossing of the bay. The new draw spans have an underclearance of 35 ft. at mean high water and of 135 ft. when the lift spans are open.

A detailed description of the bridge was given in *Engineering News-Record*, Feb. 4, 1926, p. 184.

Portland Cement Association Reviews Conditions

G. S. Brown, president, Alpha Portland Cement Co., Easton, Pa., recently has been elected president of the Portland Cement Association as noted in these columns last week. Mr. Brown succeeds Blaine S. Smith, vice-president and general sales manager, Universal Portland Cement Co. In addition to the officers mentioned last week, Robert B. Henderson, president, Pacific Portland Cement Co., San Francisco, was elected vice-president and John W. Boardman, vice-president, Huron Portland Cement Co., Detroit, was re-elected treasurer.

At the business session, Mr. Smith, retiring president, reviewed the portland cement industry for the past year and pointed out certain conditions which will influence the industry in the near future. Mr. Smith said, in part:

"A good cement demand can be expected next year although an increase over this year's consumption is not likely. Government figures for the ten months indicate total shipments for the year of 162,000,000 barrels, or about 3 per cent more than last year. At present the manufacturing capacity is about 200,000,000 barrels per year. Additional building now under way insures a total capacity of 215,000,000 barrels for next year which is 33 per cent greater than this year's indicated consumption. This large excess of capacity over demand presents a serious problem which is complicated by the menacing increase of cement imports.

"Immediate tariff legislation is unlikely but pending the time when Congressional relief can be effected, government officials and national legislators should be made acquainted with the facts. American taxes should be spent for American goods."

Ten Drown in Tunnel When Flood Waters Break Cofferdam

The sudden flooding on Nov. 25 of Claremont Tunnel under construction in California for the East Bay Municipal Utility District trapped and drowned ten workmen. San Pablo Creek passes near the tunnel about 8 ft. above tunnel grade and when the storm waters destroyed a cofferdam in the creek the resulting flood speedily entered the tunnel through a 4-ft. opening made for drainage purposes.

Investigations to fix the blame are complicated by the fact that the cofferdam that failed and the tunnel operations come under different contracts. Utility district officials report having issued warnings against the insecurity of the cofferdam and the need for closing the 4-ft. opening.

Private Company May Construct Railway to Red Lake District

E. W. Backus, head of the Kenora Paper Mills Co., Ltd., situated in northwestern Ontario, has announced that his company may construct a common carrier railway connecting the mining fields of the Red Lake district with the Canadian Pacific and Canadian National Railways. The company, he explained, proposes to build a logging railway to the outlet of Lac Suel, in connection with its operations in the English River timber limits. "If it proves to be a real mining camp up there, with a sufficient demand for transportation, we may construct a common carrier railway," he declared.

A.A.E. Endorses Engineer for President of U. S.

Through its board of directors the American Association of Engineers has passed a resolution endorsing an engineer for the Presidency of the United States. The resolution, which bears the signature of M. H. McIver, secretary of the association, is as follows:

"WHEREAS, much of the present high standard of living in this country has been accomplished through the practical application, by engineers, of scientific and engineering principles to industry; and

"WHEREAS, the more recent application of these principles to our federal government has resulted in a remarkable co-ordination of industry and government, to the great benefit of every citizen; and

"WHEREAS, future development of industry and increased prosperity of the nation are dependent upon an extension of these principles and coordination, which can best be attained by the placing of chief executive authority in the hands of an engineer;

"NOW THEREFORE BE IT RESOLVED, that the American Association of Engineers, through its Board of Directors in meeting assembled at Chicago do hereby endorse the elevation of an engineer to the Presidency of these United States."

WASHINGTON NOTES

A REPRESENTATIVE of the Corps of Engineers at Salt Lake City is about to undertake an examination of the Flaming Gorge project on Green River, it is understood. There is nothing to justify the attaching of significance to this action. The Utah Power and Light Co. recently applied for a license after having completed the studies required by its preliminary permit. In all such cases the field examination then is ordered.

Action on the license must await the withdrawal of the Federal Power Commission's resolution suspending consideration of all Colorado basin projects. All indications are that the commission will wait until after this session of Congress before acting on the Girand license and the Flaming Gorge application. If Congress fails to act at the forthcoming session on Colorado River legislation it is believed probable that the commission then will withdraw its resolution, issue the Girand license and consider the other pending applications covering projects in the Colorado river basin.

THAT the time has been reached when the pulp resources of Alaska can be used to advantage is indicated by the competition which has developed for water power rights in Alaska. William Randolph Hearst on Nov. 5 filed an application for a preliminary permit in the Tongass national forest which conflicts with the previous applications of Mark L. Requa and of Thebo, Starr and Anderton. Each of these applicants represents well financed interests. Incidentally the Hearst application covers a portion of the project of the Alaska Pulp and Paper Company which already is under license.

THE Supreme Court on Nov. 23 granted the state of New York permission to participate in arguments before Special Master Charles E. Hughes in the Chicago diversion cases. New York has a suit against Illinois and the Sanitary District of Chicago separate from that instituted by Wisconsin. On the same date, the Court granted the motions of Arkansas and Mississippi to intervene in the New York suit.

Dates Set for Two Water-Works Sectional Meetings

Dates have been announced for two sectional meetings of the American Water-Works Association.

The Kansas Water-Works Association will be held at Lawrence, Jan. 17 to 19, as a "Three-Day School for Water-Works Operators," with the state board of health and the school of engineering, University of Kansas, cooperating. (Secretary-treasurer, Ernest Boyce, director and chief engineer, state board of health, Lawrence, Kan.)

The Southeastern Water & Light Association will meet at Jackson, Minn., next April. (Secretary-treasurer W. F. Stieglitz, Columbia, S. C.)

May Extend Railway in Alberta

The province of Alberta has taken over the operation of the Edmonton, Dunvegan and British Columbia and Central Canada Ry., which has been under lease to the Canadian Pacific Ry. for some years. The C.P.R.'s operating agreement expired Nov. 10. An agreement has been completed with the Canadian National Rys. for the handling of the traffic.

The provincial government is expected to give serious consideration to the provision of extensions north and south of the Peace River from the present end of the line at Whitelaw to Waterhole on the north side of the river and from the present end of the steel at Wembley on the south to Beaver Lodge.

Supreme Court Maintains Reproduction Cost

(*Continued from p. 923*)

sumption that prices are fairly stable at the present time and at least will not be certain for some time, the court held that the spot price was an important factor in considering value, particularly as the use of the 10-year period prior to the rate-fixing time gave a value 12 to 35 per cent less than the use of a spot price. The court added that this use of spot price does not mean that the original cost or the present cost or some figure arbitrarily chosen between these two is to be taken as the measure. The weight to be given to such cost figures and other items or classes of evidence is to be determined in the light of the facts of the case in hand." The court also found that the commission had not given a proper value for working capital, for the water rights or for the going value of the company. It further made the important ruling that the actual estimate by a competent engineer of existing depreciation is more competent than any calculation, such as the straight-line theory calculation, of depreciation.

It is to be noted that the actual spot price cost of reproduction less depreciation of the property is much more than the $19,000,000 acceptable to the company. The court further approved the contention of the company that 7 per cent is a reasonable rate of return on such utilities.

Brandeis Dissents

The decision was written by Justice Butler. Justice Brandeis, in dissenting, said that the lower court, whose opinion was upheld by the majority of the Supreme Court, was not justified in its conclusion that reproduction cost is conclusive evidence of value. Justice Brandeis particularly argued against the use of spot reproduction as an evidence of value and held that the decree of the lower court should be reversed and the evidence returned for a better adjudication of the value of the property.

Justice Holmes "concurred in the result," which is taken to mean that he agrees with the final decision, but disagrees with the argument which led up to that decision.

RANDOM LINES

No. 212

THE LINGERIE ENGINEERS

(Imagine undergarments so cobweb sheer, so perfectly cut, that they cannot add even a thirty-second of an inch to your measurement.)—From a current advertisement.

The silhouette one pares and pinches
Right down to fractioned parts of inches,

And well groomed woman ne'er indulges
In even decimal pointed bulges.
Precision measurements—(Ah, me!)
By engineers of lingerie
The old time union suits have reckoned
Out to a minus thirty-second.

MORAL:

And chic is gauged, the ad infers, by measurement with calipers.

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* * *

Should Education, Like Charity, Begin at Home?

The impressive Board of Investigation and Co-ordination of the Society for the Promotion of Engineering Education has just issued the first installment of its final report. The board has its own ideas on certain fundamentals, we notice, for in two places it talks about a "concensus" of opinion, but then spelling, we suppose, is not an engineering necessity.

* * *

Walt Crosses a "Bridge"

Engineering Societies

Calendar

Annual Meetings

HIGHWAY RESEARCH BOARD, OF NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Dec. 2 and 3, 1926.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention and Road Show, Chicago, Ill., Jan. 10-14, 1927.

AMERICAN ENGINEERING COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-15, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 19-21, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, Asheville, N. C., Jan. 24-28, 1927.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1926.

The Detroit Engineering Society for its Dec. 2 meeting has planned a joint meeting and dinner with the Detroit Aviation Society, the address to be "Radio Control of Aerial Navigation" by Leroy M. Wolfe, First Lieutenant, Air Corps, and chief of the radio laboratory, McCook Field, Dayton, Ohio.

The Kansas City, Mo., Engineers Club at its Nov. 22 meeting had an address on the "National Air Transport Activities" by C. E. Fleming of the National Air Transport Co.

The Providence, R. I., Engineering Society together with the city's section of the American Society of Mechanical Engineers in joint meeting Nov. 30 had as speaker Major T. O. Freeman, president and treasurer of the Air Transport Corporation, treasurer of Colonial Airways, and commissioner of aviation for Connecticut.

The Montana Section of the American Water Works Association will hold its second annual meeting Jan. 7 and 8, 1927, at Billings. Herbert B. Foote, division of water and sewage, State Board of Health, Helena, Mont., is secretary.

Personal Notes

GEORGE S. WEBSTER, consulting engineer, Philadelphia, and a member of the board of engineers for the Philadelphia-Camden bridge until the completion of the bridge, announces that he has opened an office as consulting engineer at 1,600 Arch St., Philadelphia. Mr. Webster has given important service to Philadelphia; he was an assistant engineer in laying out the grounds of the 1876 Centennial, then assistant engineer and finally head of the Bureau of Surveys, and for some years director of the Department of Wharves and Docks. He has been a leader in engineering association work, as director, vice-president and president of the American Society of Civil Engineers, president of the American Society for Testing Materials, and president of the Philadelphia Engineers' Club.

D. ROUNESEVILLE, assistant chief engineer of the Chicago & Northwestern Ry., has retired on pension.

A. A. MATTHEWS has been appointed chief engineer of the Denver & Salt Lake R.R., at Denver, Colo., to succeed R. D. STEWART, who has been assigned to other duties.

FREDERICK PALMER, British consulting port engineer, has been engaged by the Canadian government to consider and report on plans for harbor development at Port Nelson, the proposed terminus of the Hudson Bay Ry. Mr. Palmer is a member of the firm of Handel, Palmer & Tritton, London, is president of the British Institution of Civil Engineers, consulting engineer for the port of London, the port of Glasgow and other ports, and is an expert on tidal estuaries. He recently completed for the British government a study of Takeradi Bay, on the West African coast.

REUBEN B. SLEIGHT, who has been the engineer of the Minnesota Tax Commission since 1922, has accepted a position as assistant to Commerce Secretary Hoover. He will do research work on subjects pertaining to the electrical industry. He succeeds Paul S. Clapp, who resigned recently to become secretary of the National Electric Light Association.

GEORGE J. CALDER, for the past three years resident engineer on the highway bridge now being constructed across Carquinez Strait, California, by the American Toll Bridge Co., has been elected vice-president and general manager of that company. OSCAR H. KLATT has been elected president, succeeding AVEN J. HANFORD whose death was recently announced in these columns. Mr. Calder takes Mr. Hanford's place on the board of directors.

Obituary

RICHARD C. STONE, president of the R. C. Stone Engineering Co., St. Louis, Mo., died in that city, Oct. 15, aged 68 years. Mr. Stone was born in Pittsburgh, Pa., and established his first engineering office in Springfield, Mo.; in 1912 he moved to St. Louis. His company specializes in the construction of large flour mills and grain elevators.

FRANCIS CLARKE GAMBLE, provincial engineer of railways for British Columbia, died Nov. 13. He was born in Toronto in 1848 and studied engineering at the Rensselaer Polytechnic Institute. After holding important positions in connection with several railways in Eastern Canada, he entered the service of the Dominion Department of Public Works in British Columbia in 1880, and in 1910 when the British Columbia government undertook railway construction on an extensive scale Mr. Gamble was appointed chief engineer of the Provincial Department of Railways. He was the first engineer to be chosen president of the Engineering Institute of Canada.

CHARLES F. MAURICE, of the firm of Moran, Maurice and Proctor, consulting foundation engineers, New York City, died of pneumonia on Nov. 15 at his home in Ossining, N. Y. Mr. Maurice was born 54 years ago at Athens, Pa., the son of Charles S. Maurice, one of the founders of the Union Bridge Co. His entire professional life was devoted to foundation work. Early in his career he was with John F. O'Rourke, serving on the caisson construction of the New York Stock Exchange Building in 1901. Later he was engineer for The Foundation Co., but soon after Daniel E. Moran left that organization to establish consulting practice Mr. Maurice joined him. He continued in this association to the time of his death, and for the past fourteen years has been a member of the firm.

THOMAS HUGH BOORMAN, former editor of *Architect and Builder*, died Nov. 15 at 76 years of age at his home in Glen Ridge, N. J.; he was born in England. Mr. Boorman was for years a writer for engineering publications, and the author of an early and authoritative book on asphalt, its sources and uses.

GEORGE A. GARDINER, of North Kingstown, R. I., for years division engineer of the Washington north division of the Rhode Island State Board of Public Roads, died Nov. 23 at his home on the Post Road after a short illness; he was in his 73rd year.

CAPTAIN W. PILSWORTH, civil engineer, who was engaged in railway construction work and surveying in Western Canada for over 40 years, died recently in Vancouver, B. C. In his younger days he was engaged in military service in the Zulu War and during the Riel rebellion of 1885 he commanded a company.

WILLIAM L. JONES, president of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., died at his home in that city Nov. 25. Mr. Jones graduated at Princeton in 1887 and his life was occupied with production of steel; and he was known as a leader in the industry and promoter of its development. He went into the mills in Pittsburgh in 1887 as assistant to his father, general manager of the company, and later succeeded him as general manager. In 1906 he was elected vice-president of the company and in 1922, upon the formation of the present Jones & Laughlin corporation was made its president.

ROBERT T. CREIGHTON died in November at Nashville, Tenn., aged 70 years. Mr. Creighton was chairman of the Nashville Board of Park Commissioners and a member of the firm of Foster-Creighton Co. which built many buildings in Nashville and operated stone quarries.

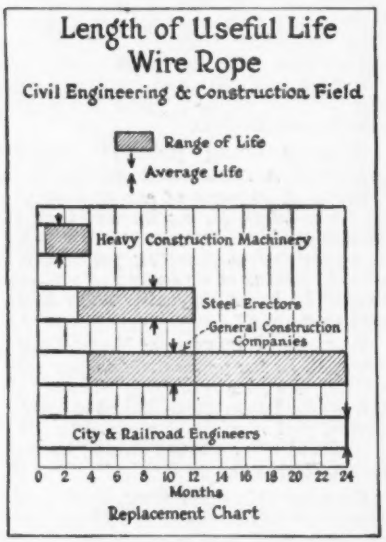
Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Survey Shows Useful Life of Wire Rope on Construction Work

Wire rope and its use on construction equipment has been the subject of a survey and analysis recently made by the market survey department of *Engineering News-Record*. The majority of construction companies report the use of from 1,000 to 10,000 lin.ft. of wire rope per year, while two companies reported a use of 50,000 lin.ft. annually.

As shown in the accompanying chart, wire rope used on heavy construction



machinery such as power shovels, cranes, piledrivers, backfilling machines, and draglines, has an average length of life of 1½ months. On general construction service, the average life is 10½ months, and for steel erection work, 9 months. On shovels and cranes, ⅝-in. and ¾-in. wire rope are most used, while for mixers ⅝-in. rope is the most common. Conveyors and loaders utilize most ⅝-in. and ¾-in. sizes, while the most important sizes for road graders are ½ in. and ⅝ in. The quality of rope used by equipment manufacturers is as follows in the order of preference: Plow steel; crucible cast steel; improved plow steel; crucible steel.

Business Notes

YALE D. HILLS has been appointed Seattle branch manager of the Timken Roller Bearing Service & Sales Co. Mr. Hills was formerly manager of the Portland branch but came to the main office at Canton, Ohio, when this branch office was closed. R. H. Cross whom Mr. Hills succeeds, has been made assistant to G. C. McMullen, district manager of sales, industrial division. Mr. Cross will continue to maintain offices at Seattle. E. N. Beisheim, formerly of the Bock Bearing Co., Toledo, has been appointed assistant to general manager of the company. S. C. Partridge has been placed in charge of the Buffalo office, industrial division.

ROBERT J. ANDERSON, INC., chemists, metallurgists and consulting engineers, 2416-38 Beekman St., Cincinnati, Ohio, with Dr. Robert J. Anderson, president, announces the opening of new commercial testing laboratories for chemical analyses and testing of metals.

HELTZEL STEEL FORM AND IRON CO., Warren, Ohio, announces that the growth of its business during 1926 has necessitated expansion, and that a new addition comprising 42,000 sq.ft. is being added to its present plant. The new addition is of the double bay type, equipped with two 10-ton cranes and other machinery necessary for the fabrication of such contractors' equipment as steel bins, road forms, etc.

New Developments

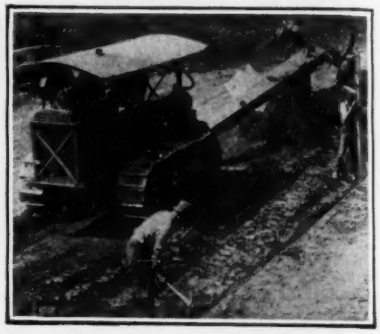
Electric Operated "Fresnos" and Graders of New Design

The accompanying illustrations show two new machines, known respectively as an earth mover and a blade grader. Both are operated by 60-hp. Caterpillar tractors and have been designed especially for use with this power equipment. They have been designed by Robert LeTourneau, a contractor in Stockton, Calif., and have been used on several jobs in central California.

Both machines are unique in design. They are operated by electric motors driven from a generator mounted on the tractor, and are entirely controlled by the driver from the tractor seat; no extra operator is required.

The earth mover consists of four telescopic buckets, each shaped something like the ordinary Fresno, all attached to a heavy frame which in turn is mounted on a Caterpillar track in such a manner that the front end can be lowered when scooping up the earth or when unloading. The machine is strictly an earth mover and is not designed to dig up hard ground, but rather to remove the loose earth previously turned by a scarifier, plow or grader. The capacity of the four sections is 12 cu.yd.

When the earth mover is empty, the four telescopic sections are collapsed somewhat the same as a folding drinking cup. As the machine is drawn forward the earth piles up and as each section is filled it is pulled back by means of an electrically operated shaft and gears. The front of the fourth section engages the back of the third section, the front of the third section engages the back of the second section and so



on until the machine is completely opened up and loaded.

In unloading, the back section is moved forward, forcing the earth off at the front end. It is claimed that the machine can dump the earth in a layer varying from 2 in. to 1 ft. in thickness. A special advantage is claimed for the machine's low center of gravity in that it can work on slopes as steep as 1½:1.

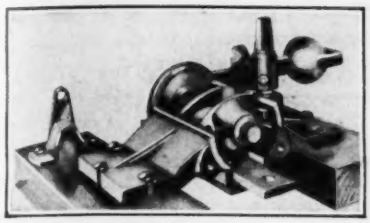
The blade grader, shown in the second illustration, has two wheels with a heavy box beam on which is another box section standard which holds the blade. The wheels are mounted on separate crank axles and separately controlled by motors.

Improved Switch Stand

By using a double grooved cam which operates the switch points and the target mast simultaneously and by completely housing all the moving parts, the Odenkirk switch stand manufactured for many years has been improved by the McMyler-Interstate Co., Cleveland, Ohio. Semi-steel is being used in place of gray iron castings. Further refinement in design permits the stand to be taken apart, examined and re-assembled in a few minutes' time. Shoulders are placed on the grooves to insure the roller and crank against any tendency to rebound and throw the points and signal out of their proper position.

When the stand is to be used on trail-

ing-through switches, it can be equipped with a breakable link and pin. The pin is the weakest point and breaks when struck, allowing the connecting rod to move and relieve the pressure on the



point. No other part of the stand is injured and by replacing the pin the stand and points are once more ready for operation. When the breakable connection is used an adjustable rod provides perfect adjustment for the switch points.

In the illustration the double grooved cam is shown exposed. A covering fits over this when the stand is in use.

Six-Wheel Trucks for Crane Mounting

Because it is claimed to give greater stability, to make possible a greater tractive effort, and to provide a smaller unit load per sq.ft. of area, the six-wheel, four-wheel drive mounting is

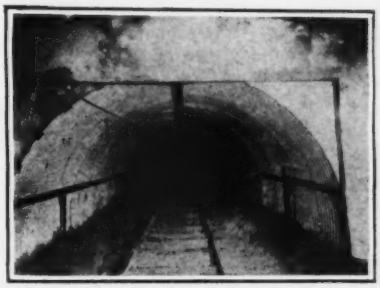
coming into use for truck cranes. In the illustration is shown a 7½-ton crane manufactured by the Universal Crane Co., Cleveland, Ohio, mounted on a six-wheel truck and operating without the use of outriggers.

A Manual for Engineers and Surveyors

C. L. Berger & Sons, Inc., Boston, Mass., celebrates the beginning of the second half century since the firm was started by issuing a new edition of its surveying manual containing 350 pages. Its purpose is to place in the hands of the users of the company's instruments detailed information concerning construction, care and adjustment such as is scarcely ever found in text books. It is a manual of surveying instruments rather than of surveying methods. Chapters, however, are given on surveying operations, triangulations, topographical surveys, mine and tunnel surveys, railway and highway surveys, and astronomical observations. The price of the manual is $2 per copy.

Sheet Steel Mine Overcast Replaces Wooden Structure

The Standard Coal Co., Salt Lake City, Utah, has designed a mine overcast built of corrugated Armco ingot iron sheets. It is claimed that the construction is done at about one-third the cost of the usual wood overcast and



that, in addition, it greatly aids mine ventilation. These overcasts are installed where haulage ways cross the air courses at right angles and where it is necessary to maintain the haulageways on level or even grades. The air goes above and at right angles to the haulageway overcast.

The height of the overcast illustrated is 9 ft. and its greatest width is 12 ft. It is 14 ft. long, made up of seven corrugated sheets each 12 ft. in length and curved on a 6-ft. radius. No. 14 gage metal is used.

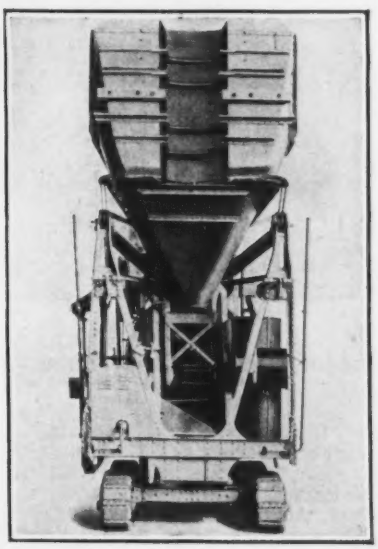
Aggregate Handling Facilitated by Bucket Elevator

In charging bins with sand and stone at central aggregate proportioning plants, the most common method is to use rehandling clamshell buckets. The George A. Zimmerman Co., Milwaukee, contractors, used a Rex elevator manufactured by the Chain Belt Co., Milwaukee, so as to save one handling of the sand and stone.

In order that the trucks may discharge directly into the elevator, it was necessary to build an inclined platform to such height as is shown in the illustration. The truck thus dumps directly into the elevator hopper. The bucket elevator measures 34 ft. between centers, and is equipped with loading buckets of malleable iron mounted on two strands of steel chain. The buckets operate at a speed of about 200 ft. per min. and have a capacity of 70 tons per hr. Power is furnished by a 15-hp. gasoline engine, the take-off being by chain drive. The storage bin and batcher illustrated are manufactured by the Blaw-Knox Co.

New Design Paver Skip Clears Center Joint

The operating adaptability of the 27E paver manufactured by the Koehring Company, Milwaukee, Wis., has been increased by the addition of a special skip for center joint construction. An arch with a clear width of 24 in. is built into the center of the skip which then comes flush to the



subgrade on either side of the joint. The skip is constructed of heavy tank steel and rigidly reinforced as shown in the illustration.

New Publications

Pipe—LOCK-JOINT PIPE CO., Ampere, N. J., discusses in its latest bulletin its reinforced-concrete pressure pipe. Illustrations and text portray the method of manufacture and drawings show details of the pipe.

Pumps.—DEAN HILL PUMP CO., Anderson, Ind., devotes a new bulletin No. 1401 to its centrifugal sump pumps. Specifications are given for the different sizes of pumps available, ranging from 1½ in. to 4 in. The remainder of the bulletin is devoted to details of pump construction.

Engineering News-Record Statistics of the Construction Industry

Dec. 2, 1926 — *in the United States* — Vol. 97, No. 23

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY
January, 1925 to Date

December, 1926	**210.80**
November, 1926	210.80
December, 1925	205.95
Peak, June, 1920	273.80
1913	100.00

1925

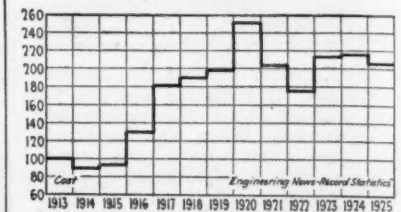
Jan.	210.40	May	207.20	Sept.	202.10
Feb.	209.70	June	204.60	Oct.	205.35
March	210.20	July	204.60	Nov.	205.95
April	209.55	August	204.60	Dec.	205.95

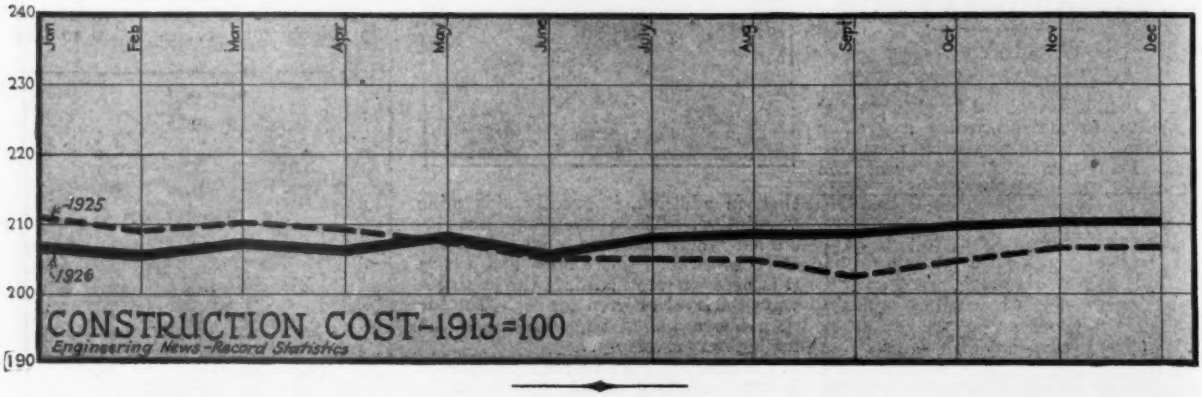
1926

Jan.	207.15	April	207.05	July	207.80
Feb.	206.55	May	207.30	Aug.	208.30
Mar.	207.65	June	204.80	Sept.	208.30
		October	209.80		

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is unchanged from the November level. The average rate for common laborers is still 55¼c. per hr. for the entire country as compared with the same rate one month ago and 54c. at this time last year. Thus, general construction cost is 2 per cent above December, 1925, 23 per cent under the peak and 110 per cent above the 1913 level.

YEARLY
1913 to 1925





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY
January, 1925 to November, 1926

November, 1926	**211**
October, 1926	244
November, 1925	194
Peak, August, 1925	266
1913	100

1925

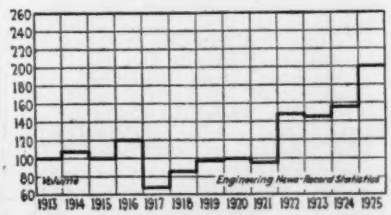
January	141	May	209	September	262
February	145	June	214	October	233
March	161	July	178	November	194
April	211	August	266	December	206

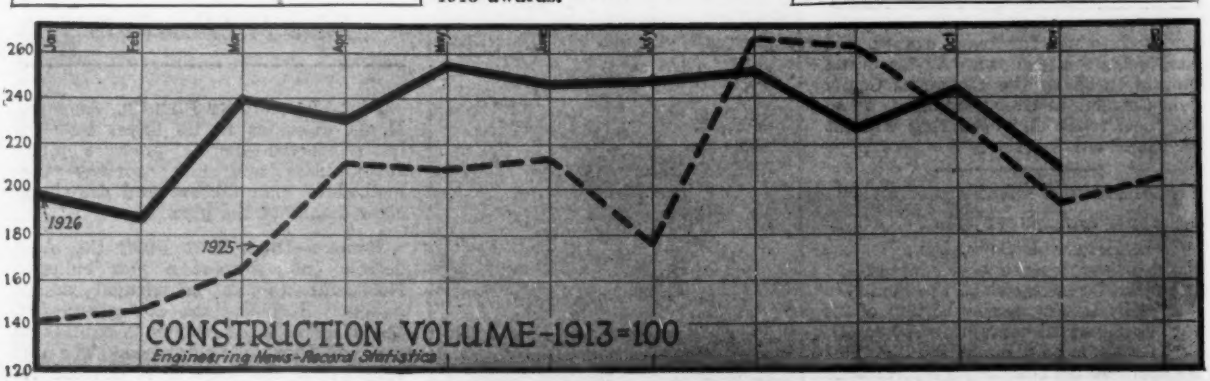
1926

Jan.	198	April	233	July	248
Feb.	187	May	254	Aug.	252
Mar.	240	June	246	Sept.	227

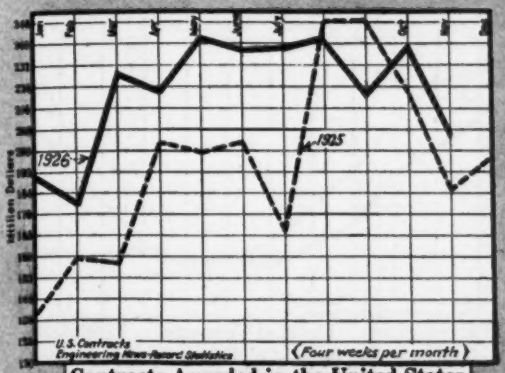
ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 211 for the month of November and 201 for the whole of 1925, as against 100 for 1913. This means that the actual volume of contract letting in 1925 (not the mere money-value of the contracts let that year) is 101 per cent above the volume for 1913. The monthly volume number, 211 for November, 1926, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

YEARLY
1913 to 1925

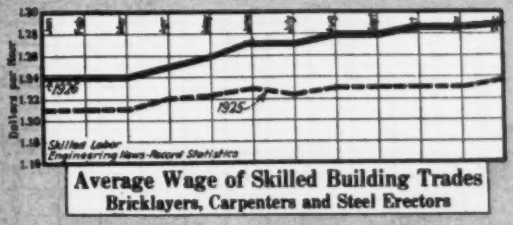




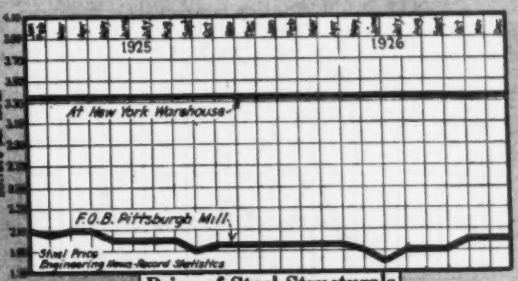
Monthly Statistics of the Construction Industry



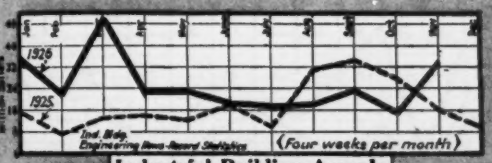
Contracts Awarded in the United States
Reported in E. N.-R.



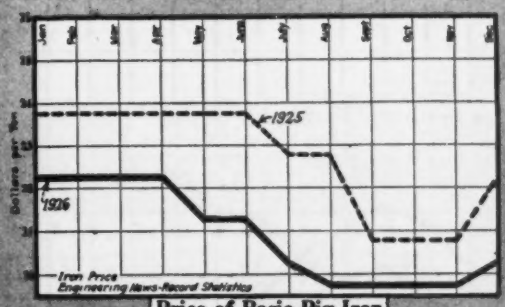
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



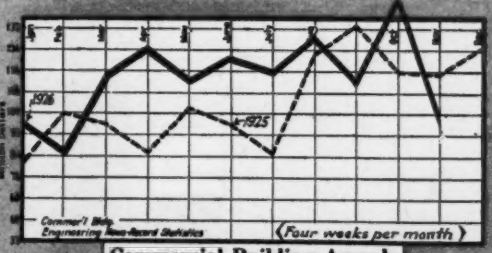
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



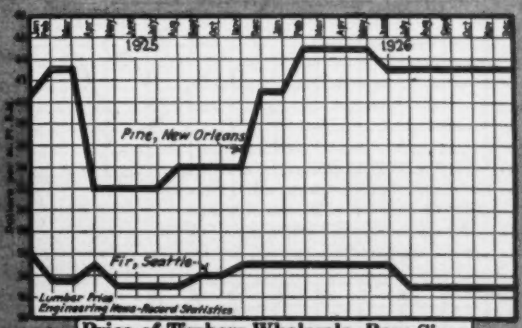
Industrial Building Awards
$40,000 and Over



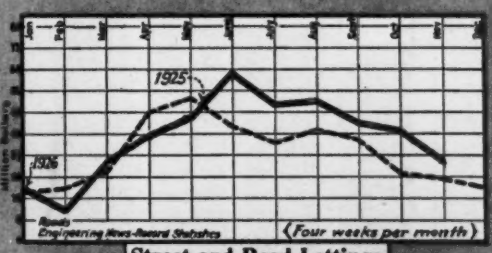
Price of Basic Pig Iron
F.o.b. Pittsburgh



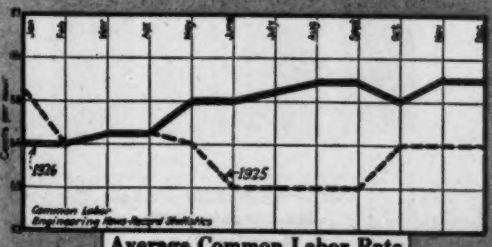
Commercial Building Awards
$150,000 and Over



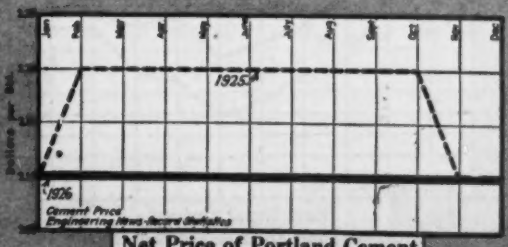
Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors



Street and Road Lettings
$25,000 and Over

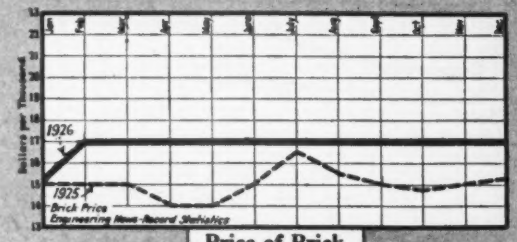


Average Common Labor Rate
Pick and Shovel Men

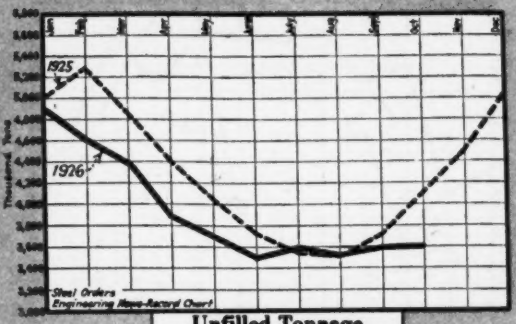


Net Price of Portland Cement
Car Lots, f.o.b. Chicago

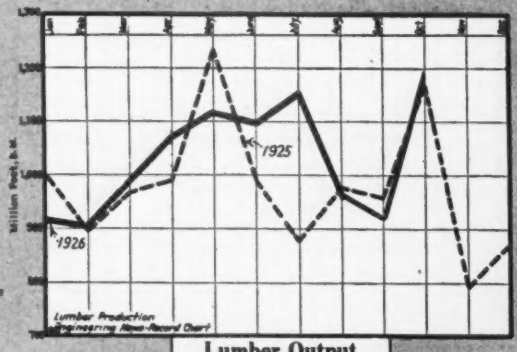
Monthly Statistics of the Construction Industry



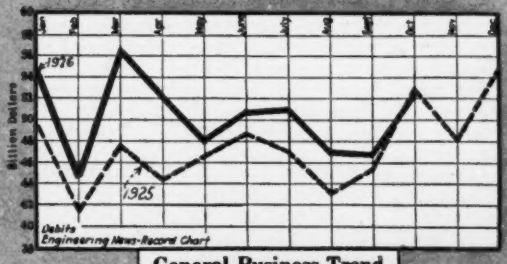
Price of Brick
At Dock, New York



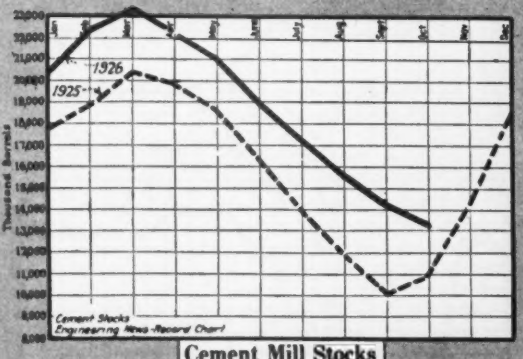
Unfilled Tonnage
On Books of U. S. Steel Corp.



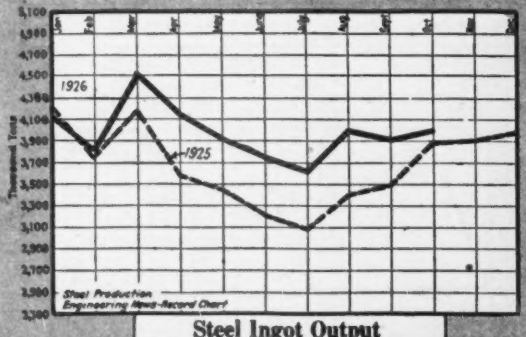
Lumber Output
Nat. Lumber Mfrs. Assn.



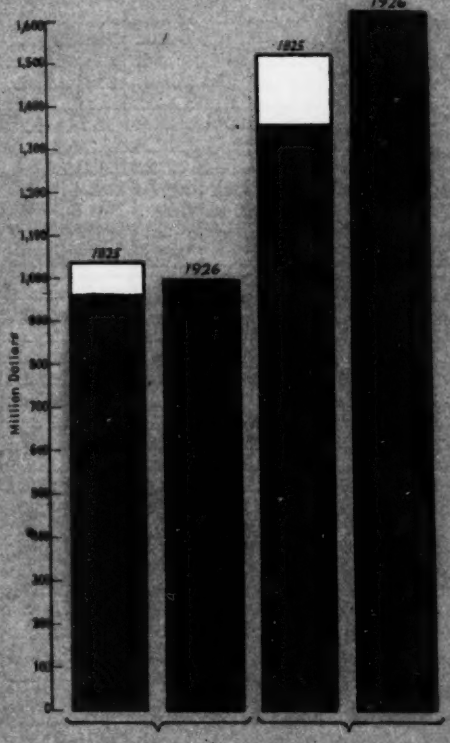
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Stocks
Bureau of Mines



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.

Heaviest November On Record In Money Value of Contracts

Gains In New England, South and West

AT THE present rate of contract letting this year will show a lead over 1925 of 13 per cent, or more, in money value of awards, according to *Engineering News-Record* statistics.

November contracts exceeded those of the same month last year by 11 per cent.

The total for the month just closed was 13 per cent below October, but the decline was mainly seasonal and occurred chiefly in water-works, sewer, street and road, commercial building and Federal Government construction. Substantial gains, however, were reported in bridge, industrial building, and excavating jobs, and privately owned unclassified projects.

In the accompanying table a minimum for each class of construction has been adopted as follows: water-works, and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial, educational, religious and other buildings, $150,000. Under the head of excavations are included drainage, irrigation, levee, river and harbor work.

While the November total was under that of the month preceding for the nation as a whole, sixteen states registered substantial gains, these were, Maine, Massachusetts, Rhode Island, Connecticut, North Carolina, Mississippi, Louisiana, Tennessee, Arkansas, South Dakota, Kansas, Texas, Ohio, Wisconsin, Arizona, and Oregon.

Money value of November awards, all classes, as reported in *Engineering News-Record*, for the last fourteen years, are as follows:

1913	$54,021,000	1920	$66,263,000
1914	33,523,000	1921	82,372,000
1915	74,421,000	1922	127,684,000
1916	90,708,000	1923	151,944,000
1917	74,030,000	1924	123,994,000
1918	59,335,000	1925	185,600,000
1919	67,893,000	1926	206,821,000

The ten largest jobs awarded during the month follow: Mill, Quebec, Canada, Anglo Canadian Pulp & Paper Co., to W. I. Bishop, Ltd., Montreal, $15,000,000; Grading and masonry, on new railway line in Ohio, C. & H. Ry. Co., to Fritz-Rumer Constr. Co., Columbus, $12,500,000; Loft and office, New York City, Merchants Sq. Corp., to G. Richard Davis & Co., Inc., $6,000,000; Warehouse and cold storage plant, Montreal, Que., Montreal Rail & Harbor Terminal, Ltd., to Park-Lap, Inc., Toronto, $5,000,000; Gas supply line and distribution system, Texas Gas Co., to Connor Constr. Co., and others, $4,000,000; Midland Club, Chicago, Ill., to Duffy-Noonan Constr. Co., $4,000,000; Office, loft and store, New York City, Park Ave. and 33rd St. Corp., to Schroder & Koppel, $4,000,000; Office and store, Chicago, Ill., Syndicate, to Hegeman-Harris Co., $3,500,000; Road construction, N. Y. State Hy., to J. H. Murray, Rochester, and others, $3,276,862; Dam on Colorado River near Bluffton, Texas Pub. Util. Co., Waco, company forces, $3,000,000.

Value of Contracts Let in the United States and Canada, November, 1926

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date U.S.	Canada
Water-works	$164,000	$118,000	$737,000	$1,050,000	$1,193,000	$257,000	$3,519,000	$55,750,000	$212,000
Sewers	.....	1,212,000	389,000	3,930,000	403,000	2,702,000	8,636,000	96,449,000	2,115,000
Bridges	1,178,000	2,655,000	1,498,000	135,000	373,000	147,000	5,986,000	77,824,000	661,000
Excavation, drainage, irrigation	62,000	.....	1,691,000	26,000	107,000	89,000	1,975,000	22,021,000	70,000
Streets and roads	2,093,000	7,643,000	5,929,000	3,428,000	4,002,000	3,101,000	26,196,000	459,829,000	500,000
Industrial buildings	3,680,000	6,165,000	13,355,000	5,681,000	3,188,000	740,000	32,809,000	291,256,000	32,085,000
Commercial buildings	16,626,000	35,010,000	2,256,000	25,279,000	6,683,000	13,673,000	99,527,000	1,300,795,000	3,915,000
Federal Government	19,000	54,000	19,000	15,000	5,000	29,000	141,000	46,790,000	.....
Unclassified	209,000	451,000	785,000	17,116,000	8,349,000	1,122,000	28,032,000	286,165,000	755,000
November, 1926	$24,031,000	$53,308,000	$26,659,000	$56,660,000	$24,303,000	$21,860,000	$206,821,000	$2,622,183,000	$40,313,000
October, 1926	14,028,000	74,974,000	16,035,000	77,017,000	18,358,000	38,432,000	238,844,000	.....	5,291,000
November, 1925	11,518,000	64,228,000	21,039,000	38,378,000	25,804,000	24,633,000	185,600,000	.....	5,985,000
Jan. 1 to date, 1926	227,349,000	791,276,000	269,319,000	686,719,000	381,543,000	285,977,000	2,622,183,000	.....	140,709,000
Jan. 1 to date, 1925	187,671,000	834,210,000	224,155,000	422,280,000	381,956,000	262,252,000	2,312,524,000	.....	81,835,000

Labor Rates and Conditions Throughout the Country

Increasing Pressure for Five-Day Week

FEW strikes and wage controversies and a limited amount of unemployment, consistent with the seasonal recession in construction volume, characterize the present situation in the building trades throughout the country.

It might be added that the present movement for the five-day week is diverting much of the pressure away from demands for higher wage schedules in the skilled crafts.

San Francisco, St. Louis and Boston appear to be the only centers where effects of serious strikes are still being felt.

The fight in San Francisco between union carpenters and the supporters of the open-shop plan, is now in its eighth month with no settlement at hand. The Impartial Wage Board met Nov. 17 to start a series of open hearings for the purpose of amicably settling wage questions in the following trades: Elevator constructors, painters and decorators, structural ironworkers, plasterers, steamfitters, and carpenters. In the case of the last mentioned craft, the Wage Board will avoid the present open-shop controversy and confine its deliberations to the matter of wage schedules.

Thirteen unions in Boston were enjoined from sympathetic strike on operations of the Scully Co. and sub-contractors. This order took effect Nov. 19 and terminated a strike action started during the latter part of August, 1926.

A building laborers' strike in Providence, R. I., started several weeks ago, was ended Nov. 5 by an agreement with employers involving higher wage schedules to hold until June 1, 1927.

Philadelphia reports a surplus of building trades mechanics, particularly carpenters, cement finishers, painters, and steamfitters. Greater slackness in the building crafts prevails now than at any time since 1921.

Birmingham, on the other hand, continues building at a brisk pace. In other local industries employment continues equally active, railroads, for instance, are taking on additional forces at the shops. The remaining seventeen cities, reporting regularly to E. N.-R., show labor conditions normal to the season, so far as building trades mechanics are concerned.

Reports depict the Los Angeles building trades as being congested by floaters from colder sections of the country. Motion picture mechanics and trades threaten strike for the closed shop.

A strike of union electricians threatens to tie up one building project in St. Louis. The action started over an electrical connection for an oil burner made by an employee of the burner company, which operates on the open-shop plan.

Four hundred New Orleans plasterers, who went on strike Oct. 26, returned to work last week at a rate of $1.25 per hr. for one year, at the expiration of which time the schedule will be advanced 25c. per hr.

The national level of wages in the skilled building trades now stands approximately 95 per cent above the 1913 level. The rate for common, unskilled labor is about 192 per cent above 1913. This does not favor common laborers so much, when it is considered that in 1913, the skilled rate was 247 per cent above that of common laborers for the nation as a whole. Compared with a year ago, skilled men get 4 per cent more, while common laborers receive an average wage about 3 per cent above the December, 1925 level. See charts on p. 931.

According to studies of the Bureau of Labor Statistics, the petroleum refining industry pays the highest wages for common labor, with general contracting (construction) next and auto-

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.62½@1.75	1.00@1.10	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.40@1.05	.75@1.00	.50@.75	.....	.75@1.75	.20@.40
Boston	1.40	1.25	1.25	.79	1.15	1.25	—.45@.74
Cincinnati	1.50	1.31¼	1.31¼	.95	1.31¼	1.31¼	.45@.58
Chicago	1.62½	1.10@1.50	1.00@1.50	.90	+1.50	1.50	.90
Cleveland	1.50	1.25	1.30	.87½@1.10	1.10	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	1.00	1.00	.30@.50
Denver	1.62½	1.25	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.40@.55
Detroit	1.50	.90@1.15	.85@1.00	.90	.85@1.00	1.12½	.50@.60
Kansas City, Mo	1.50	1.17½	1.25	.90	1.12½	1.25	.35@.75
Los Angeles	1.37½	1.00	1.00	.87½	.80	1.00	.50
Minneapolis	1.25	.87½@95	.87½	.75	....	1.00	.45@.60
Montreal	1.00	.75	.60	.40	.50	.75	—.30
New Orleans	1.50	.90	1.00	.75	.80	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90⅜
Philadelphia	1.50@1.62½	1.12½@1.25	1.02¼	1.12½	1.00	1.12½@1.25	.45@.50
Pittsburgh	1.62½	1.50	1.37½@1.50	1.12½	....	1.50	.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	+.62½

mobiles third. It frequently happens, however, that ordinary pick-and-shovel or clean-up men in construction operations are granted higher wages than are accorded common laborers in any other American industry.

Monthly Prices of Construction Materials

Ups and Downs of the Market

WHILE the general cost level remains unchanged from that of a month ago, there are some slight declines worth mentioning. The recessions occurred in pig iron, railway ties, sewer pipe, asphalt, sand, gravel, hollow tile, lumber, linseed oil, scrap, and manila rope. Substantial advances are reported in track supplies, common brick and cut nails.

Pig Iron—The collapse of fuel prices following the termination of the British coal strike, has greatly weakened pig iron in the New York and Pittsburgh markets; Birmingham, however, holds firm. Compared with November levels, Cincinnati and Pittsburgh markets are up 50c. and Philadelphia, $1 per ton.

Railway Supplies—Buying of materials is fairly active in this class, with quotations slightly above a month ago in track supplies. Railway ties are a trifle lower in Chicago.

Pipe—Lap-welded steel pipe is moving in good volume; butt-weld sizes are slower. Prices remain unchanged in steel tubular goods, while c.-i. pipe shows slight softening compared with a month ago. Seattle and Boston report seasonal decline in sewer pipe.

Road and Paving Materials—Few price fluctuations are normally expected in this group at this season of the year. The only changes occurring in the last four weeks were: a drop of $1 per ton in package asphalt at Baltimore; a substantial decline in 5-in. granite blocks at New York; a rise of 10c. per sq.yd. in granite blocks in Kansas City, Mo.

Sand, Gravel and Crushed Stone—Seattle prices are down 25c. per cu.yd. in sand and gravel; no other changes of importance occurred elsewhere during the month.

Lime and Cement—There are just about as many advances as declines in the current lime market. Natural cement dropped 5c. per bbl. in Kansas City; portland cement, 5c. in Boston; while the Philadelphia price of the latter is 9c. per bbl. higher than in November.

Brick and Hollow Tile—Common building brick are up $1 at Los Angeles and $2 per M. delivered in Detroit, compared with last month's levels. A drop of 50c. per M., however, occurred in Kansas City, Mo. Hollow tile prices declined in Boston during the month; the current level at New York is slightly below that of a year ago.

Structural Steel—Finished material remains unaffected by the recent flurry in fuel and iron and shows fairly active demand in railway as well as building steel. Tin plates and steel sheets hold firmly to present quotations, while lessened buying without actual drop in prices is evident in steel bars and automotive material. Steel plates are still $1.90, with shapes and bars at $2 per 100 lb., Pittsburgh mill, in carload quantities or over.

Lumber—Declines predominate, in comparing prices with those in effect a month ago. The softening of the market cannot be said to affect one species or grade any more than another. Orders and shipments are sufficiently ahead of production to eliminate heavy reserve stocks.

Linseed Oil—The trend of the market is definitely downward in New York, Chicago and Minneapolis.

Scrap—The Chicago market is off about 25c. per ton. All grades are moving slowly in the principal centers of distribution, in sympathy with the prevailing dullness in pig iron.

Miscellaneous—Cut nails have advanced 5c. at Pittsburgh mills and 25c. per 100 lb. keg in San Francisco, since November. Steel sheetpiling declined 5c. per 100 lb. at Pittsburgh and manila rope is down 0.5c. in Boston and 2c. per lb. in Seattle, compared with November.

Special Tabulation of Unit Prices

Vitrified Sewer Pipe

The following units costs are included in the low bidders' estimates on 6-in. pipe in various sections of the country, 1922-26:

Location	Date	Lin.Ft.	Price per Lin.Ft.
Marion, O.	Aug., 1922	6,000	$0.20
		100	.30
Lublock, Tex.	Nov., 1922	40,499	.45
Matawan, N. J.	Mar., 1923	100	.66
Riverside, Calif.	Apr., 1923	25,372	.75
Pottstown, Pa.	Apr., 1923	19,100	.40
Chicago, Ill.	July, 1923	4,000	.80
Stroud, Okla.	Jan., 1924	2,210	.30
Omaha, Neb.	May, 1924	3,000	.315
Winterset, Ia.	June, 1926	1,518	.80

Pavement

The following unit costs (materials plus labor) are included in the low bidders' estimates on various concrete paving jobs in state highway work.

Location	Date	Cu.Yd.	Price
Maine State Highway	Aug., 1922	7,763	$9.50
Conn. State Highway	Sept., 1922	11,000	6.75
Del. State Highway	Apr., 1923	6,760	14.95
Del. State Highway	June, 1923	9,725	13.95
Del. State Highway	July, 1923	3,800	16.30
Calif. State Highway	Dec., 1923	22,220	14.20
Calif. State Highway	Jan., 1924	21,750	14.25
Del. State Highway	June, 1924	7,100	14.75

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Dec. 2	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$24.19	$24.05
Northern Basic	**20.89**	24.27
No. 2 Southern Ohio (silicon 1.75@2.25)	21.39	24.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	26.37	28.37
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	20.00	22.00@23.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	**23.76**	24.16
Virginia No. 2 (silicon 2.25@2.75)	**28.19**	29.17
Basic	21.26	23.16
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	21.00	23.00
No. 2 Foundry Southern (silicon 2.25@2.75)	24.55	26.55
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	**20.76**	22.27
Basic	**20.26**	22.27
Bessemer	**21.26**	22.27

SCRAP—The prices following are f.o.b. per net ton paid by dealers:

	New York*	Chicago	Birmingham
No. 1 railroad wrought	$14.00@$15.00	$12.50@$13.00	$12.00@**$13.00**
Stove plate	10.00@ 11.00	*13.75@ 14.25*	14.00@ 14.50
No. 1 machinery cast	16.00@ 17.00	*16.00@ 16.50*	17.00@ 17.50
Machine shop turnings	9.25@ 9.75	*6.00@ 6.50*	8.00@ 8.50
Cast borings	10.00@ 10.25	**8.75@ 9.25**	8.00@ 9.00
Railroad malleable	16.00@ 16.50	*14.25@ 14.75*	16.00@ 17.00
Re-rolling rails	12.50@ 13.00	14.50@ 15.00	15.00@ 16.00
Re-laying rails	23.00@ 24.00	.....	21.00@ 22.00
Heavy melting steel	11.50@ 12.00	11.50@ 12.00	13.00@ 14.00

*Gross ton.

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Dec. 2	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	.....
Standard openhearth rails	43.00	43.00	43.00	43.00	$51.00
Light rails, 8 to 10 lb.	.....	.....	34@36	1.80@1.90*	2.05-2.15*
Light rails, 12 to 14 lb.	.....	.....	34@36	1.80@1.90*	1.88-1.98*
Light rails, 25 to 45 lb.	36.00	36@38	34@36	1.80@1.90*	1.84-1.94*
Re-rolled rails	**28**@30	30@34	*30.00*	34@36	18@21

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.45	$1.83
Chicago, empty cell creosoted	*1.85*	2.45
Chicago, zinc treated	*1.65*	*2.15*
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.20	1.45
St. Louis, zinc treated	1.60	1.85
St. Louis, red oak, plain	1.10	1.35
St. Louis, sap pine-cypress	.95	1.20
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Dec. 2	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80@$2.90	$2.90@$3.00	$3.55	$3.65	**$4.35**	$3.00
Track bolts	3.90@4.25	3.90@ 4.15	4.55	4.60	**5.85**	3.90
Standard section angle bars	**3.75**	2.75	3.40	3.75	3.60	4.15

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	30	12

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black New York	Black Chicago	Black Birmingham	Black St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
2½ to 6 in. lap welded	48%	51%	59%	46%

	Galvanized New York	Galvanized Chicago	Galvanized Birmingham	Galvanized St. Louis
1 to 3 in. butt welded	39%	41%	50½%	36%
2½ to 6 in. lap welded	35%	38%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Burlington, N. J.	New York Dec. 2	New York One Year Ago
4 in.	*$43.00*	*$52.00*	*$54.60*	$54.60@56.60
6 in. and over	*39.00*	*48.00*	*50.60*	50.60@52.60

	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	*$51.60*	*$51.20*	*$49.60*	*$53.00*
6 in. and over	*47.60*	*47.20*	*45.60*	*49.00*

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Dec. 2	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$48.00	$40.00	$45.00	.....	$73.00
4	55.00	50.00	40.00	56.00	$76.50	110.00
5	.....	.....	.....	80.00	97.75	118.00
6	90.00	92.00	70.00	100.00	127.50	150.00
8	160.00	160.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.088	$0.10	.....	$0.09	$0.12	.....
4	.....	.088	.10	$0.10	.09	.15	$0.15
5	.....	.121	.135	.....	.13½	.18	.18
6	$0.24	.121	.21	.14	.13½	.21	.21
8	.43	.198	.315	.225	.21	.30	.325
10	.50	.231	.45	.315	.31½	.42	.476
12	.65	.297	.54	.405†	.40½	.56	.612
15	1.08†	.396	.75	.675†	.54	.92	1.02
18	1.55†	.55	.90	.945†	.75	1.32	1.53
20	1.89†	.66	1.20	.....	.90	.....	.....
21	.....	.77	1.25	1.26†	.....	.....	.....
22	2.52†	.88	1.35	.....	1.20	.....	1.564
24	2.84†	.99	2.665	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.952	2.45†	2.75	3.00	3.34
30	5.16†	2.664	3.96	3.00†	3.75	3.60	4.06
33	6.98†	3.60	4.51	3.55†	4.50	.....	4.99
36	8.00†	4.10	5.06	3.95†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	*$0.12*	*$0.18*	*$0.26½*	*$0.53*	$2.00†	$5.50†
Minneapolis	.....	.....	.25	.45	1.50	4.56
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	*.63*	*2.52*	.....
Los Angeles	.1675	.186	.2825	.504	1.74	.....
New Orleans	.205	.40	2.27	3.50	.....	.....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal	.....	.50	.90	1.35	4.50	.....
Detroit	.111	.1665	.259	.4995	1.665†	3.7925†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15	.21	.29	.52	1.90†	3.80†
Philadelphia	.11	.16	.26	.42	1.50	3.70

*4-in., 6-in., 9-in., respectively. †Double Strength.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum, f.o.b. place named:

		Dec. 2	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065 @$0.07	$0.065 @$0.07
New York, 65% asphalt	(at terminal)	.0675@ .0725	.0675@.0725
New York, binder	(at terminal)	.07 @ .075	.07 @.075
New York, flux	(at terminal)	.07 @ .075	.07 @.075
New York, liquid asphalt	(at terminal)	.07 @ .075	.07 @.075
St. Louis, 40@50% asphalt		.0503	.0525
St. Louis, 50@60% asphalt		.0523	.055
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 50% asphalt		.1455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00	$18.50
Boston (*Mexican*)	23.00	18.50
Chicago (*Texas*)	27.00	22.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities* (*Standard*)	27.60	21.60
St. Louis (*Mexican*)	27.00	24.00
Baltimore (*Standard Oil*) (*f.o.b. refinery*)	*22.50*	18.50
Montreal (*Imperial*)	27.00	22.50
Atlanta (*Mexican*)	23.40	19.40
Detroit (*Mexican*)	22.25	18.50
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermudez*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	27.30	24.30
Los Angeles ("*D*" *grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

* F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	*$1.52. 40* per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	2.75 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.25 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., 85c. per lin.ft.; roundings, $1.35. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3¼	18	2.40
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.40
St. Louis	4	16	2.75
Seattle	4	16	Off market
Minneapolis	3½	16	2.40
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	.....
Cincinnati	3½	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor, f.o.b., per cu.yd., is as follows:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Dec. 2	One Year Ago	Dec. 2	One Year Ago	Dec. 2	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.85	1.50	1.85	1.50	1.65	1.40
St. Louis	1.45	1.45	1.45	1.45	.93	1.08
Seattle	*1.85*	1.50	*1.85*	1.50	*1.85*	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.65*	1.65*	1.65*	1.25	1.25
Cincinnati	1.30†	1.40†	1.30†	1.40†	1.05†	1.35†
San Francisco	1.80	2.15	1.80	2.15	1.40	1.50
Boston	1.50†	1.50†	1.50†	1.50†	1.00†	1.00†
New Orleans	2.10†	2.60	3.00†	2.60	1.80†	1.75
Los Angeles	1.95†	.85*†	1.95†	.85*†	1.70†	.50*†
Atlanta	1.90†	2.20†	1.90†	2.20†	1.60†	1.65†
Detroit	1.45†	2.02	1.35†	2.02	1.10†	1.62
Baltimore	1.40	1.40	1.60	1.60	.70*†	.70*†
Montreal	1.25†	1.25†	1.50†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.50	1.50
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City, Mo.	4.00‡	....	4.00‡	....	.70*†	.66*†

New York—Grits, $1.75 per cu.yd.; ready mixed $1.85.
* At pit † Per ton. ‡ Joplin chats.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd. f.o.b. city, is as follows:

	1½ In.		¾ In.	
	Dec. 2	One Year Ago	Dec. 2	One Year Ago
New York	$1.84	$1.75	$1.94	$1.85
Chicago	1.70	1.72½	1.87½	1.87½
St. Louis	1.83*	1.93*	1.93*	1.93*
Dallas	2.40	2.40	2.83	2.83
San Francisco	1.70	2.15	1.70	2.15
Boston	1.60*	1.60*	1.60*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	2.00	....	2.00	....
Denver	2.50	2.50	2.50	2.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.50*	2.20*	2.50*	2.20*
Cincinnati	1.65*	1.90*	1.65*	1.90*
Los Angeles	2.10	1.00*	2.10*	1.00*
Detroit	2.60*	2.00*	2.60*	2.00*
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	2.00*	1.50
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	2.70*	3.25*	2.70*	3.25*
Birmingham	2.00	2.00	2.00	2.00

* Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant

	1½-In	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Buffalo District	1.25	1.35	2.25	1.25
Birmingham, Ala	.90	1.25	2.05	.80
Cleveland, Ohio	1.70*	1.70*	....	1.40*
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25

*Includes freight charge.

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$11.00	$3.50*	$2.10@3.00*
Chicago	20.00	18.00	.....	1.50†
St. Louis	23.50	19.50	.....	2.03*
Boston	18.50	12.00	*3.55*	*2.85*
Dallas	19.00	.....	.....	1.82†
Cincinnati	16.80	11.90	.....	11.40‡
San Francisco	.....	22.00	.....	1.60†
Minneapolis	25.50	21.00	.....	1.70†
Denver	24.00	.....	.....	2.70*
Detroit	15.25	11.25	.....	11.75‡
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	25.00	*15.00*	3.50*	19.00‡
Baltimore	24.25	.....	2.55†	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	22.00	13.00	.....	1.40†
New Orleans	24.00	15.00	2.60†	2.25*
Philadelphia	23.00	16.00	.....	.....
Kansas City	18.50	17.50	2.45†	2.10*
Birmingham	22.50	16.00	2.40†	1.85†

* Per 280-lb. bbl. (net). † Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Dec. 2	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.40*	1.35
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.65	2.75
St. Louis (Carney)	2.35	2.50
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 2	One Month Ago	One Year Ago
New York, del. by truck	$2.50@$2.60	$2.50@$2.60	$2.50@$2.70
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.25*	2.30	2.40
Chicago	2.10	2.10	2.10
Pittsburgh	2.09	2.09	2.09
Cleveland	2.29	2.29	2.29
Detroit	2.15	2.15	2.15
Indianapolis	2.29	2.29	2.29
Milwaukee	2.25	2.25	2.25
Duluth	2.09	2.09	2.09
Peoria	2.27	2.27	2.27
Cedar Rapids	2.34	2.34	2.34
Davenport	2.29	2.29	2.29
St. Louis	2.20	2.20	2.20
San Francisco	2.31	2.31	2.31
New Orleans	2.40	2.30	2.40
Minneapolis	2.32	2.32	2.32
Denver	2.85	2.85	2.84
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.35
Cincinnati	2.37	2.37	2.67
Los Angeles	2.50	2.20	2.52
Baltimore	2.50	2.50	2.50
Birmingham	2.40	2.40	2.40
Kansas City, Mo	2.35	2.35	2.30
Montreal	1.15	1.15	1.80
Philadelphia	2.50	2.41	2.41
St. Paul	2.32	2.32	2.32
Toledo	2.20	2.20	2.20

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.85	Hudson, N. Y.	$1.95
Universal, Pa	1.85	Leeds, Ala	1.95
Steelton, Minn	1.90	Hannibal, Mo	1.95
Fordwick, Va	2.05	Lehigh Valley District	1.85
Mitchell, Ind	1.95	Wyandotte, Mich	1.90
Iola, Kan	1.85	Alpena, Mich	1.75
Mason City, Ia	1.90	Richard City, Tenn	2.05
La Salle, Ill	1.95	Kingsport, Tenn	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.16	1.66	1.67	1.91
093	45	1.98	2.03	2.77	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.11	3.14	3.10	.....
180	78	3.35	3.43	5.70	3.60	3.47	.....
245	103	4.43	4.53	6.21	4.75	4.58	.....
287	119	5.12	5.24	7.19	5.50	5.26	6.35
336	138	5.93	6.07	8.35	6.37	6.11	.....
395	160	6.88	7.04	9.65	7.38	7.12	.....
			PAVING				
036P	17	$0.76	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.07	1.09	1.50	1.14	1.07	.....
072P	31	1.35	1.38	1.90	1.45	1.39	.....
097P	40	1.74	1.78	2.45	1.87	1.90	.....
049R	24	1.07	1.09	.....	1.14	1.02	.....
067R	31	1.35	1.38	.....	1.45	1.39	.....
089R	40	1.74	1.78	.....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in less-than-carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$17.50	$24.00	$19.50	$20.50	$23.50	$24.00
2.5	18.50	26.00	20.50	21.50	26.00	26.00
3.0	21.00	28.50	23.00	24.00	29.50	29.00
3.5	22.50	30.50	24.50	25.50	31.50	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb., in carload lots, f.o.b., except at New York and St. Louis warehouses:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00	$2.25	$3.24	*$2.30@$2.50*	$3.15	$2.75	$2.95
⅝	2.10	2.35	3.34	*2.40@ 2.60*	3.25	2.85	3.05
¾	2.20	2.45	3.44	*2.50@ 2.70*	3.35	2.95	3.15
⅞	2.40	2.65	3.64	*2.70@ 2.90*	3.55	3.10	3.35
1	3.00	3.25	4.24	*3.30@ 3.50*	4.15	3.75	3.95

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ in and larger	$2.35	$2.48	½	$2.75	$2.88
⅝	2.45	2.58	⅝	3.35	3.48
¾	2.55	2.68	¾	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Dec. 2	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 3½-inch*
New York (del.)	$20.40–22.40	$20.40–22.40	$17.50–19.50	$45.00	$51.00
New York (at dock)	17.00	17.00	14.50	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	15.00	15.00	16.00	40.00	42.50
Denver, salmon	9@10	9@10	12.00	.....	.....
Dallas	14.10	14.10	11.10	35.00	.....
San Francisco	15.00	15.00	15.50	.....	.....
Los Angeles	**11.00**	10.00	11.50	(not used)	
Boston (del.)	19.00	19.00	17.50	45.00	50.00
Minneapolis (del.)	13.75	13.75	13.50	.....	.....
Kansas City	*14.00*	14.50	14.50	(no market)	
Seattle	15.00	15.00	15.00	.....	**55.00**
Cincinnati	15.50	15.50	17.00	40.00	45.00
Montreal	20.25	20.25	17.50	100.00†	
Detroit (del.)	**16.00**	14.00	16.00	38.40	41.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	12.00	12.00	10.50	40.00	
New Orleans	15.00	15.00	15.00	60.00	**75.00**
Birmingham	14.50	14.50	12.50	40.00	45.00
Philadelphia	18.00	18.00	15@18	**P** 40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	12@14	12@14	14.00	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Dec. 2 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1027	$0.1112	$0.088	$0.105	$0.068	$0.108	.....
6x12x12	.1541	.1667	.119	..	.09	.156	.....
8x12x12	.1926	.2084	.165	.205	.126	.244	.....
10x12x12	.....	.....	.21	.....	.158	.....	$0.252
12x12x12	.....	.....	.233	.....	.188	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	*$0.08*	*$0.17*	*$0.27*
Minneapolis (f.o.b. cars)	.068	.1175	.205
Minneapolis (delivered)	.076	.13	.225
Cincinnati	.064	.1295	.1726
Kansas City	.088	.154	.252
Denver	.075	.155	.188
Seattle	.09	.18	.26
Los Angeles	.085	.172	.....
New Orleans	*.11*	.205	*.31*
Detroit	.0707	.1326	.1853
Montreal	.10	....	.....
Baltimore	.124	.268	.....
Atlanta	.0895	.1837	.....
Dallas	.112	.19	.31
Birmingham	.11	.124	.255
Pittsburgh	.068	.128	.179
Cleveland	.062	.12	.....

STRUCTURAL MATERIAL—Following are base prices per 100 lb in carload lots, f.o.b. mill, Pittsburgh and Birmingham, together with quotations in less-than-carload lots from warehouses at places named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	2.00	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	2.00	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	2.00	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.90	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Dec. 2	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.50@ 2.60	$4.20	$4.50	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	2.90	$4.40	$4.70	$3.70	$3.85	$5.20	$5.00
⅝ and ¾	3.05	4.55	4.85	3.80	4.20@4.45	5.35	5.15
⅞ and 1	3.30	4.80	5.10	4.05	4.60	5.60	5.50

NAILS—The following quotations are per 100 lb. keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.85	$3.05	$3.75	$4.00	$2.83	$4.95
Cut	**2.90**	2.90	....	**5.25**	5.00	2.93	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs $2.31 per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $6.49 per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $5.09 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$72.80
Asphalt coating per bbl	17.00
Asphalt felt, per ton	74.20

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 87 per cent; "B," 89 per cent. Double thickness "AA," 82 per cent; "A," 86 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.40	$3.60	$3.50	$3.90	$3.89
No. 12	2.45	3.65	3.55	3.95	3.94
No. 14	2.50	3.70	3.60	4.00	3.99
No. 16	2.60	3.80	3.70	4.10	4.09
Black					
Nos. 18 to 20	2.90	4.25	3.75	**4.70**	4.15
No. 22	3.05	4.40	3.90	**4.85**	4.30
No. 24	3.10	4.45	3.95	**4.90**	4.35
No. 26	3.20	4.55	4.05	**5.00**	4.45
No. 28	3.35	4.70	4.20	**5.15**	4.60
Galvanized					
No. 10	3.25	4.55	4.10	**5.05**	4.40
Nos. 12 to 14	3.35	4.65	4.20	**5.15**	4.50
No. 16	3.45	4.75	4.30	**5.25**	4.60
No. 18	3.60	4.90	4.45	**5.40**	4.75
No. 20	3.75	5.05	4.60	**5.55**	4.90
No. 22	3.80	5.10	4.65	**5.60**	4.95
No. 24	3.95	5.25	4.80	**5.75**	5.10
No. 26	4.20	5.50	5.05	**6.00**	5.35
No. 28	4.45	5.75	5.30	**6.25**	5.60

For galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York: Dec. 2	New York: One Year Ago	Chicago: Dec. 2	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$0.86¼*	$0.99	*$0.84*	$0.99

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Dec. 2	1 Yr. Ago	Dec. 2	1 Yr. Ago
Red	$15.25	$15.25	$16.75	$16.75
White	15.25	15.25	15.25	15.25

Lumber

Prices wholesale, per M. ft. b.m., to contractors in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to contractors at yards.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
1x14	30.00	30.00	32.00	34.00
	24 Ft. and Under		25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00		$30.00	$32.00
6x14	34.00		36.00	38.00
8x10	28.00		30.00	32.00
8x14	34.00		36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No. 1 L.L.Y.P.	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$43.00	$44.00	$42.25	$40.50
3x10 to 10x10	50.00	51.00	47.00	40.50
3x12 to 12x12	57.00	58.00	57.00	40.50
3x14 to 14x14	65.00	66.00	.....	40.50
3x16 to 16x16	77.00	78.00	.....	42.00

New York—Wholesale price of long-leaf yellow pine timbers (rough) to dealers; to contractors, delivered from lighters or cars to job, $5@$10 additional. Short-leaf pine costs $3 per M. ft. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 ft.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$49.00	$48.00†	$50.00	$51.50	*$59.00*	$58.00†
Seattle	.....	24.00	.....	.....	.....	25.00
New Orleans	36.00	.....	.....	.....	52.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	*49.75*
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	55.00	.....	.....	60.00	50@65
Los Angeles	.....	33.00	.....	.....	.....	33.00
Denver	.....	*32.75*	*32.75*	*32.75*	.....	33.75
Minneapolis	42.50	38.75	34.50	.....	45.00	38.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	56.00	.....
Kansas City, Mo.	42.50	*40.75*	.....	.....	57.75	*40.75*
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	54.00	38.00	38.00	45.00	65.00	38.00
Detroit	47.75	46.75	.....	.....	61.75	46.75
St. Louis	41.00	.....	.....	.....	53.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	*$44.50*	$42.00†	$45.00	*$49.50*	$48.00†
Seattle	.....	22.00	.....	.....	*23.50*
New Orleans	*38.00*	46.00	.....	*28.00*	34.00
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	45.00	50.00	40.00	65.00	50.00
Los Angeles	.....	27.00	.....	.....	36.00
Denver	.....	*32.75*	33.25	.....	*30.25*
Minneapolis	*32.75*	36.25	34.75	36.00	34.25
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.25	.....	.....	56.00	.....
Kansas City, Mo.	51.25	41.75	.....	43.50	*36.50*
Birmingham	*25.00*	.....	.....	45.00	.....
Philadelphia	30.00	38.00	36.00	35.00	37.00
Detroit	39.75	37.00	.....	46.50	41.25
St. Louis	43.00	.....	.....	29.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Bare	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Dec. 2	One Month Ago	One Year Ago
$2.25@$2.30	$2.25@$2.35	$2.25@$2.30

CONCRETE MASONRY UNITS—Standard 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	$0.18*
Detroit	.16	Boston	.22
New Orleans	.25*	Minneapolis	.15*
New York (Brooklyn)	.18@.20	Philadelphia	.18@.20
Pittsburgh	*.17*	*F.o.b.	

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.21*	New Orleans	$0.21
New York	.23	Los Angeles	.25
Chicago	.22½	Seattle	*.22*
Minneapolis	.24½	St. Louis	.22½
San Francisco	.22	Montreal	.17
Atlanta	.30	Detroit	.24½
Denver	.24@.25	Baltimore	.18
Cincinnati	.21	Kansas City	.25
Dallas	.30	Birmingham	.26@.27
Philadelphia	.25		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	.23	.25
Kansas City	.22	.245
Seattle	.165	.19
Chicago	.195†	.2175†
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.306
Los Angeles	.1875	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.1675	.1895
Birmingham	.22	.24
New Orleans	.235	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatin in case lots. †Quantities above 500. lb. and less than a ton.

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	4.80@4.90
Soda ash, 58%, in bags, per 100 lb	1.38@1.55
Chlorine, liquid, tanks, per lb	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.